Minimum Standards for Long-term Video-EEG Monitoring

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Summary

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Highlights

1. This clinical practice guideline seeks to recommend the current standards to be used during long-term video-EEG monitoring.
2. There existing high-level evidence for the utility and performance of long-term video-EEG monitoring is limited.
3. Comprehensive recommendations addressing minimum standards for performing long-term video-EEG monitoring are needed.
4. Clinicians, hospital administrators, and insurance company representatives will benefit from understanding standards for video-EEG monitoring as it applies to patient management.

Summary

The objective of this clinical practice guideline is to provide recommendations on the indications and minimum standards for long-term video-EEG monitoring (LTVEM). The Working Group of the International League Against Epilepsy and the International Federation of Clinical Neurophysiology have developed the guidelines aligned with the Epilepsy Guidelines Working Group. We reviewed the published evidence using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement. We found limited high levels of evidence aimed at specific aspects of LTVEM performed to diagnose patients with seizures and nonepileptic events. For classification of evidence, we used the Clinical Practice Guideline Process Manual of the American Academy of Neurology. In the absence of high-level evidence, we used the modified Delphi method. We used GRADE to formulate the recommendations for the clinical indications for LTVEM in the evaluation of patients with suspected epilepsy. Further research is needed to establish long-term outcomes from LTVEM, that will enhance evidence for direct clinical utility.

1. Introduction

With more than 70 million cases of epilepsy are reported world-wide, objective measures are needed to evaluate people for seizures.[1-4] Seizures impart safety risk,[5] affect people of all ages, gender, ethnic background, and cultures,[2, 4] with one-third of people who are uncontrolled by antiseizure medication (ASM).[6, 7] Practice guidelines and quality measures are available providing national and international standards for diagnosis and treatment of patients.[8-10] Because the manifestations of epilepsy are intermittent, a standard EEG often fails to reveal the epileptiform activity necessary to support the diagnosis of epilepsy. Long-term video-EEG monitoring (LTVEM) is therefore the most robust reference standard for recording epileptiform activity and seizures.[11] In this clinical practice guideline, LTVEM refers to scalp EEG monitoring using the 10-20 system of electrode placement and a single channel of electrocardiogram (ECG). Video-EEG remains the best technique to evaluate people with recurrent paroxysmal events with and without impaired consciousness when routine evaluation is unrevealing[5, 12-20] Position papers and standards[16], services[21] and guidelines[11, 14, 22-25] exist for specific indications and certain aspects of LTVEM, though an international guideline to identify minimum performance standards is needed. The International League Against Epilepsy (ILAE) and the International Federation of Clinical Neurophysiology (IFCN) are developing clinical practice guidelines for application of neurophysiological methods in people with epilepsy. The target audience for this clinical practice guideline are clinicians and allied healthcare personnel. The objective of this guideline is to provide recommendations on standards performance of LTVEM.

2. Study Methods

We extracted, reviewed and evaluated published evidence on standards of practice in LTVEM and used the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement for a breakdown of article selection **(Figure 1).**[26] Data sources included PubMed and EMBASE supplemented with articles from Ovid Medline, CINAHL (Cumulative Index of Nursing and Allied Health Literature), and Cochrane databases including conference proceedings. The search was restricted to human subjects, but no language restriction was applied during article inclusion. The search strategy included broad search terms (“epilepsy AND seizures AND video-EEG) and synonyms (“epilepsy AND Seizures AND telemetry) pertaining to LTVEM and subtopics evaluated (i.e., “epilepsy AND standards/guidelines”). Article search took place before Oct 16, 2019 and additional relevant articles were selected thereafter for inclusion when high-level evidence was identified. Neonates and continuous EEG monitoring during critical illness were excluded. Two independent reviewers screened titles and abstracts and full text articles were examined for eligibility.

Due to the large heterogeneity in study design and the use of different LTVEM outcomes quantitative synthesis (meta-analysis) was not possible. Therefore, we conducted a qualitative synthesis of high-level studies that are listed in **Table 1.** We posed questions to address patient populations, interventions, comparators, and measured outcome (PICO) aimed at answering the following questions

(Table 2): (1) What are the indications for LTVEM that influence outcome? (2) What are the technical requirements for LTVEM? (3) What are the essential practice elements for performing LTVEM?

Individual studies were rated using predefined criteria to evaluate the evidence reflecting risk of bias given the paucity of high-level evidence.[11, 27, 28] Category I studies were composed of prospective trials, with either a control group or with two patient groups from a broad spectrum cohort one with and other without the disease. Broad spectrum studies described important confounders in their baseline population. Category II were narrow-spectrum prospective trials or large broad-spectrum retrospective trials. Category III were narrow-spectrum retrospective trials or case-control studies. Category IV was all other studies including small retrospective studies. The most relevant articles were identified, rated, and linked to recommendations predicated on category I and II rated studies. Pre-existing guidelines, consensus/position statements, and task force proposals were incorporated when applicable. Studies had to specify key outcome metrics (diagnosis and management) according to the STARD (Standards for Reporting Diagnostic Accuracy Studies) criteria.[29, 30] High-level evidence was classified, rated, and subjected to a second rating. We used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system to formulate recommendations.

We developed this clinical practice guideline as evidence-based and consensus-driven modeled after the Epilepsy Guidelines Working Group.[31] The ILAE Commission on Diagnostic Methods and the Executive Committee of the IFCN each appointed members of the Working Group. The Working Group and the guideline development protocol was approved by the Guidelines Task Force before starting the literature search. Two face-to-face meetings were held. Where relevant high-level evidence was absent, we used the Delphi process[32] to obtain blind consensus when majority agreed.[23]

3. Indications

Epilepsy and neurology communities have produced 11 references to LTVEM in the form of guidelines and position papers, though limited comprehensive assessment outside individual topics exists[16]. Principal clinical indications for LTVEM include: (1) differential diagnosis between epileptic seizures and nonepileptic attacks (2) classification and (3) quantification of seizure types and epilepsy syndromes, and (4) electroclinical characterization of focal seizures during presurgical evaluation in patients with drug-resistant epilepsy[14, 16, 22, 33].

3.1 Differential Diagnosis

LTVEM is most used for differential diagnosis of epileptic and non-epileptic attacks with compelling evidence from 143 LTVEM papers (no category I, 6 category II) for clinical usefulness to distinguish between them.[17, 34-38] One category II study viewing samples of video and EEG to categorize diagnoses demonstrate good inter-rater reliability for epilepsy, but only moderate reliability for psychogenic nonepileptic attacks (PNEA), and only fair inter-rater reliability for physiologic nonepileptic events.[39, 40] Overall, some reports reveal PNEA in approximately 20-30% of patients admitted for diagnostic LTVEM[35, 37] but others note a wider prevalence between 5% and 50%.[41, 42] Misinterpretation of an EEG has been one reason leading to misdiagnosis.[41-46] A meta-analysis of 135 VEM studies found 60% of referrals were for diagnostic reasons.[47] Another reason for misdiagnosis are due to spells demonstrating generalized motor activity.[48] These may be challenging to distinguish from epileptic seizures based on clinical grounds alone.[49] In 181 consecutive patient LTVEM recordings, the clinical diagnostic question was answered in 67%.[50] In older adults (mean age 51 years), LTVEM was useful in 93.5% of 31 patients with pure PNEA.[34] Standards for diagnosis of PNEA include use of LTVEM developed by an international consensus group of clinician-researchers.[51] A diagnostic LTVEM outcome study in 230 people resulted in a change in diagnosis in 133 (58%) and refinement of a diagnosis in 29 (13%) to provide overall diagnostic value in 87% of patients. It was particularly useful to differentiate epileptic seizures from non-epileptic attacks as well as frontal lobe seizures from generalized seizures.[36] Similarly, another study found 58% of 131 patients had their diagnosis altered by LTVEM, with the greatest change being an increase from 7 to 31% of patients with nonepileptic attacks.[17] Following LTVEM the diagnosis was reversed in 29 (24%) out of 121 patients and 4 diagnoses changed from nonepileptic to epileptic seizures.[37] Overall, LTVEM identified patients with pure PNEA to be more common than patients with a dual diagnosis[38, 52] and physiological non-epileptic events.[19] One category II controlled study of 1083 patients from Poland evaluating PNEA in 85 (7.8%) on clinical grounds: 48 patients were believed to manifest only PNEA and 37 patients were suspected of both PNEA and epileptic seizures.[38] When LTVEM was performed only 9/230 (3.9%) patients had a dual diagnoses demonstrating the pitfall for a dual diagnosis based on clinical grounds alone. Another retrospective comparative cohort of 49 patients with PNEA noted 18.2% manifested pseudostatus.[53]

A systematic review involving 33 papers on diagnostic procedures including seizure induction, Minnesota multiphasic personality inventory, prolactin levels, single photon emission computed tomography (SPECT), and clinical metrics (i.e., pre-ictal pseudosleep, ictal, and post-ictal characteristics) found no procedure attained reliability equivalent to VEM.[54] Overall, specificity was better than sensitivity ranging from 56-100% compared with 23-96% with none of the tests investigated demonstrating both high sensitivity and specificity. In one pediatric retrospective diagnostic accuracy study, chart review found superior sensitivity of 54% and comparable specificity of 88% for LTVEM compared to standard EEG even in the absence of a typical seizure or spell.[55] LTVEM sessions were significantly shorter in a group of 221 patients undergoing LTVEM for diagnosis (mean: 2.4 days) than for those admitted for presurgical evaluation (3.5 days).[37] In a series of 148 consecutive patients evaluated with LTVEM over approximately 3 years there was a significant reduction in ASM usage in people with epilepsy and PNEA after the procedure.[34] By providing a definitive diagnosis, potential adverse consequences of unnecessary ASM and invasive procedures may be averted by LTVEM[56].

The highest-level studies in this area included 6 level II studies which are downgraded due to unexplainable inconsistencies between these studies but upgraded due to the magnitude of effects. The overall confidence in evidence for these studies is therefore moderate for LTVEM to provide differential diagnostic utility in differentiating epileptic from non-epileptic events.

Recommendation: LTVEM monitoring should be used to differentiate between epileptic and non-epileptic events, in patients where the diagnosis is in question (strong recommendation).

3.2 Classification

Classification of seizures and epilepsy syndromes is essential for appropriate selection of ASM.[43, 57, 58] The International Classification of Epileptic Seizures divides seizure types into focal and generalized.[59] LTVEM-proven epilepsies support a continuum of disease[11, 58, 60-62] providing definite diagnosis beyond history, clinical seizure types, neurophysiologic, and neuroimaging features.[13, 19, 24, 59, 63, 64] A prospective study of inpatient LTVEM (at least 3 hours) clarified the epilepsy syndrome in 93% of patients, one-third of whom were eligible for epilepsy surgery.[65]

Alternative classification systems based purely on semiology have been proposed[66]. A prospective comparison (category II) between ILAE and semiological seizure classification systems in 78 consecutive patients found seizure classification changed significantly from baseline following LTVEM using the ILAE more than the semiological classification.[40] Another adult semiology study (category IV) of 90 patients found some seizure types (e.g., myoclonic and hypermotor seizures) had excellent consistency between historical description and a LTVEM confirmed diagnosis while other types (focal seizures) were less reliable.[67] In a study (category IV) of 323 children (mean age of 7 years), episodes of staring, myoclonic jerking, abnormal eye movements, and posturing, 53% were correctly reclassified by new information derived from LTVEM.[68] Other retrospective (category IV) studies involving patients with juvenile myoclonic epilepsy reported focal clinical and generalized EEG features in about one-half of patients blurring the clinical diagnosis.[69, 70]

Most studies on the role of LTVEM to classify seizures are category III and IV. They proved useful in distinguishing between focal and generalized epilepsy in 47/230 (35%) in one study.[36] A large retrospective LTVEM-based surgical series classifying patients by EEG found a focal EEG in two-thirds, generalized abnormality in 22%, lateralized features in 4%, and 6% that were mislocalized or mislateralized.[71] Sleep-related seizures may be diagnosed and correctly classified (focal vs generalized) by overnight LTVEM.[72, 73] A small retrospective study found a significant increase in the percentage of generalized epilepsy diagnoses (more than double) after LTVEM.[17] Genetic Generalized Epilepsies (GGE) have not found gene defects to be a reliable classification method,[74] and IEDs are neither seizure type nor epilepsy syndrome specific.[75, 76] LTVEM is able to classify and subclassify GGE,[77] and reclassify seizure types to select appropriate ASM.[43]

There was a single class II study and the overall confidence in evidence is low to utilize LTVEM for purposes of classifying patients with epilepsy**.**

Recommendation: LTVEM may help classify patients with epilepsy in whom the seizure type or epilepsy syndrome is undetermined (weak recommendation).

3.3 Seizure Quantification

Thirty articles (category III and IV) addressed seizure quantification and LTVEM. LTVEM studies demonstrate fewer than 50% of seizures (47-63%), on average, are correctly represented by patients with accuracy of reporting varying over time.[78] One (category IV) questionnaire study of patient's subjective self-awareness of a seizure found 44.2% of LTVEM-proven seizures went unnoticed.[79] Still, self-reporting is the foundation for clinical decision-making of seizure patients including regulatory trials leading to approval of ASM.[80] Long-term ambulatory EEG and LTVEM studies reveal 20-25% of patients are always unaware of seizures.[81-85] At risk groups include patients with temporal lobe epilepsy (TLE) and focal impaired awareness (non-motor) seizures[79, 82, 84], fluctuating cognitive decline[86-89] and transient epileptic amnesia.[90, 91] In a (category III) LTVEM study evaluating 327 consecutive TLE patients, subclinical seizures were detected in 8.3%, and 1% had only subclinical seizures recorded (all of which were detected within first 24 hours).[92] Using post-ictal surveys during LTVEM, patients with convulsions associated with GGE were more self-aware of them than those with focal to bilateral tonic-clonic seizures.[81]

Patients with generalized epilepsies, severe epilepsy, and those with frequent seizures are good candidates for seizure quantification by LTVEM. Convulsions are readily identifiable,[93] however, absence seizures and bursts of generalized epileptiform activity may be subtle and subclinical unless response testing is performed. Also failure to recognize nocturnal seizures may occur in up to 86% of patients.[94] LTVEM can quantify seizure frequency and identify clinical phenomenology that could potentially allow medication changes to yield a more favorable response to treatment[95] and lead to improved patient outcomes.[84]

Multiple lower-class studies were inconsistent and the confidence in evidence for utility of video-EEG monitoring to quantify seizures is low. All studies demonstrate patients under or overestimate their seizure frequency. Expert opinion for quantification using LTVEM is generally accepted when objective information is required for management.

Recommendation: The usefulness of LTVEM to quantify seizures in patients with epilepsy is weak.

3.4 Seizure Characterization for Surgical Management

Three prospective longitudinal cohort studies of patients with newly diagnosed epilepsy treated with ASM fail to show a decline in the drug-resistant epilepsies over 2 decades.[96] Despite new advances,[97] risks for morbidity and mortality exist for patients when seizures are uncontrolled.[98-101] Two category 1 randomized controlled clinical trials in adults, and one trial in children demonstrate effectiveness of epilepsy surgery against best medical practice following LTVEM.[98-100] Position statements recommend epilepsy surgery be considered when patients are resistant to ASM.[101] Epilepsy surgery is under-utilized,[102, 103] with more than 10 million people worldwide who are potential surgical candidates.[104, 105]

Multiple category III and IV studies stratify surgical candidacy based upon LTVEM results.[47, 106] Scalp-based VEM and invasive EEG (iEEG) during LTVEM are standard neurophysiological techniques to characterize the seizure onset zone for surgery.[11, 47] Few studies characterize seizure-onset denoted by EEG patterns relative to outcome.[107, 108] A category III study involving 3057 seizures in 75 consecutive focal epilepsy patients after successful epilepsy surgery compared matched scalp and iEEG seizures from separate LTVEM sessions.[106] A multivariate analysis revealed, a localized scalp EEG at seizure onset (independent of location) predicted a favorable outcome after surgery, [106] while multilobar and widespread seizure onset predicted unfavorable surgical outcomes.[106, 109] Other retrospective category III studies involving combined scalp and iEEG during VEM demonstrate moderate to favorable sensitivity and specificity for patterns predicting localization in patients with TLE.[110, 111] In a prior report analyzing 61 patient with lesional focal epilepsies, 71 pairs of seizure-onset patterns matched between scalp and iEEG found some scalp seizure-onset patterns that were highly associated with a specific intracerebral pattern of the depth localized seizure-onset zone.[105] Single-center (category IV) studies suggest some focal extratemporal scalp patterns predict a seizure-free outcome.[112] In contrast, other reports found dissimilar generators were capable of producing similar scalp-based ictal patterns.[113, 114] A consortium funded by the European Union performed a systematic review and meta-analysis.[115] Pooled estimates were calculated for sensitivity and specificity with respect to postsurgical seizure freedom. They found LTVEM had substantial heterogeneity across studies and were associated with moderate sensitivity and low specificity in identification of the epileptogenic zone. Higher sensitivity was seen in lesional TLE compared to lesional ETLE.[115] As a result, guidelines for epilepsy surgery across Europe based upon the diagnostic accuracy of LTVEM were implemented.[115] Due to lack of evidence for the utility of LTVEM in children, a modified Delphi process of pediatric epilepsy experts developed consensus-based guidelines for LTVEM in the pre-surgical evaluation of children in the United Kingdom (UK).[23]

For patients with TLE there were two class 1 studies in adults and 1 class 1 study in children with indirect evidence of efficacy for surgical treatment compared to best medical therapy following LTVEM. There is high confidence in evidence that LTVEM should be used as part of the presurgical evaluation for TLE patients. For extra temporal epilepsies there is low confidence in evidence for LTVEM use to characterize seizure during presurgical evaluation.

Recommendation: LTVEM must be used in the presurgical evaluation in drug resistant TLE patients (strong recommendation). There is neither evidence for nor against LTVEM to characterize patients with drug-resistant extra temporal epilepsy in the presurgical evaluation (weak recommendation).

4. Yield of VEM

The overall diagnostic yield of LTVEM varies widely among studies ranging from 19% to 75% depending upon the definition of utility, methodology, and cohort of patients evaluated[11, 13, 17, 35, 37, 50] but appears independent of the hospital setting.[116] A systematic review found most of the literature on LTVEM focused on the noninvasive and invasive pre-surgical evaluation prior to epilepsy surgery.[47] A large, prospective study demonstrated that LTVEM was useful to clarify the clinical diagnosis in 56.3% of patients,[117] and subsequent meta-analysis found the pre-admission diagnosis changed in 35.6% of patients following LTVEM prompting change in management.[47] Successful LTVEM sessions are significantly longer in the presurgical group than in the diagnostic groups.[35] No difference in diagnostic yield has been identified with respect to age,[19, 118-120] patients with neurological impairment,[121] or reason VEM was performed.[35] One retrospective study did not find a correlation between preadmission seizure frequency and yield for recording events during LTVEM.[122] Furthermore, even patients who previously had ambulatory EEG,[118] and those who had prior LTVEM, were found to have additive value in up to 77% of patients.[35] In a prospective comparative study (category II) of 129 patients with 10 month follow-up, after LTVEM, the diagnostic categories were changed from pre-admission in 41.1% of the patients, and 40.3% had revisions in management.[123]

Pitfalls in VEM exist to compromise yield. Semiology alone may be vague or insufficient and post-ictal features over-interpreted and misdiagnosed as PNEA.[11, 124, 125] There is a small risk that provocation by suggestion may lead to false positive results in patients with PNEA necessitating identification of the habitual event.[126] Results from category IV studies involving EEG over-interpretation in patients with PNEA misclassified as epileptic seizures[43, 127] have been noted following LTVEM. During VEM, approximately 20% to 30% of patients with epileptic seizures and PNEA never have a seizure during hospitalization for VEM[41, 128, 129] leading to "inconclusive" results. In patients with epilepsy, VEM may not reveal IEDs in EEG and be devoid of a detectable scalp ictal rhythm during focal aware seizures[130, 131] falsely leading to misdiagnosis as PNEA.[132] Further, patients with PNEA can generate rhythmic movement artifacts that falsely mimics an electrographic seizure[133] or become obscured due to hyperkinetic epileptic seizures limiting identification of seizure onset in patients evaluated for epilepsy surgery.[134] Scalp ictal EEG may falsely localize and lateralize focal seizures,[135] especially those arising from mesial and posterior quadrant neocortices[126, 136] potentially resolved when invasive EEG is performed.[137, 138] One class II study provides low confidence in evidence that more than one-third of patients will experience a change in management after undergoing VEM.

Observation: LTVEM may result in a change in management in some patients (weak recommendation).

5. Technical standards

Minimal technical standards are essential to ensure high-quality recording, adequate storage, optimal review, and web-based remote exchange of information among providers at full-service epilepsy centers and in the community.[125, 139] Evolving digital technology and computer sophistication of instrumentation has transformed the practice of LTVEM[140] leading to improved technical standards.[141] International equipment guidelines for optimal methods of LTVEM including signal processing and electronic transfer, and larger storage capacity have facilitated widespread use in developed countries.[14, 142, 143] However, high-level evidence-based standards evaluating equipment and instrumentation is unavailable with heterogeneity for current clinical practices for LTVEM.[144] We identified standard technical parameters for LTVEM using the modified Delphi method[32] to reach an unprompted blind majority consensus of expert opinion **(Table 3)** by web-based survey questionnaire.

5.1 Electrode array and EEG recording

During LTVEM, EEG is telemetered over days through a cable or radio link in the hospital while behavior is documented by video. Computing power permits LTVEM to acquire and analyze a signal from the brain.[145] LTVEM and variations in sensory number and design allow signal detection from deep [146] and small regions of brain.[147] Interictal EEG abnormalities alone are insufficient to provide a definitive diagnosis.[19, 63] A recent IFCN guideline evaluating the evidence for diagnosis and monitoring with EEG in people with epilepsy has been published separately.[11] Consensus was reached for LTVEM to use a greater number than the standard 21 electrodes used for standard EEG recording. Both the 10-20 and 10-10 international system of electrode placement were endorsed. We support recommendations for use of standard IFCN array of 25 electrodes (children and adults) during scalp-based LTVEM augmenting the basal temporal regions.[25] Dense EEG arrays during LTVEM and high sampling rates show even greater source localization.[25, 148-150] This compares to a minimum of 16 channels for diagnostic LTVEM, and 32 for presurgical evaluation that has been recommended by the ACNS.[14, 22] Routine use of basal temporal electrodes but not sphenoidal, nasopharyngeal, naso-ethmoidal electrodes is recommended. No consensus was reached regarding use of diagnostic electrode caps. Nor was consensus reached to recommend maximal allowable scalp electrode impedance though values less than 5 kΩ are routinely applied.[25, 139] Consensus was reached for LTVEM to accommodate use of all forms of invasive electrodes.

Foramen ovale electrodes received negative consensus for use. Incorporating polygraphic recordings depend upon the focus of a specific clinical problem.[151-154] Oximetry, extra-occulogram, respiratory and tremor monitors with scalp recording are multimodal options during LTVEM. All raters recommended EKG recording was necessary to record during LTVEM.

LTVEM operating systems require hard drive memory capability to acquire at least 200 GB to allow for continuous monitoring up to one-week including software applications.[155] Solid-state multichannel amplifiers should be optically isolated and follow minimum technical standards of recording standard EEG.[11, 139] Consensus was reached for analogue to digital converters today using 16-bit or higher, sample rates of more than 256 samples/second, and minimum filter settings between 0.5 Hz and 70 Hz. Following acquisition and digitization EEG signals should connect to a central computer capable of storing at least 24 hours of continuous VEM data.[22] Network connectivity is required for media viewing and information transfer to archive data by technologists or junior physicians. There was consensus support to maintain the entire video and EEG files until LTVEM reporting was finalized. A recent retrospective 15-year study (category III) involving 1025 cases noted a trend of a rising population of patients with normal VEM results increasing from 4.1 to 24.1%.[156] Polygraphic recordings supplement LTVEM when abrupt motor signs occur.[157-159] Noninvasive dense arrays approach may have similar localizing ability to invasive EEG (iEEG) in patients with focal seizures.[160, 161] But there are technical challenges to recording dense array EEG during LTVEM, including limited data streaming and poor long-term tolerability of EEG head nets, so only low level evidence and expert consensus exists to support the use of dense array LTVEM in complex cases when patients are considered surgical candidates.[160, 162, 163]

5.2 Video

Video recording is routine in LTVEM[164-166] in concert with EEG in expanding numbers of EMUs.[117, 167, 168] One camera is standard for LTVEM, however some centers use two cameras to provide complementary information from different viewing points. Prospective multi-rater studies (category II and III) have shown that compared with LTVEM, video alone may be useful when evaluating the clinical description of patients with observed seizures,[125, 169] with similar sensitivity (category III) compared with EEG[170] in various patient populations.[171] Implementing video recording added to EEG increases the diagnostic yield over EEG alone[172, 173] detailing semiological classification.[66] However, no uniform nomenclature and consistent classification system differentiates patients with epilepsy from PNEA by video alone during LTVEM[174], although semiologies[42] allow hierarchical clustering.[175, 176] Based on video data alone, a prospective LTVEM study involving 5 epilepsy experts found 7/23 (30%) cases by all raters correctly classified epileptic seizures and PNEA.[177] A prospective study analyzing 120 seizures from 35 consecutive subjects detailing semiology found of 45 signs demonstrated on video, only 3 signs for epileptic seizures and 3 for PNEA were significantly useful in categorizing seizures, and no single clinical feature was sensitive and specific for either event.[178] Video recorded seizure phenomenology during VEM identifies patterns[179] that may localize or lateralize signs with relative specificity for their involvement.[180]

Standard digital audio-video data is acquired with MPEG level 1 or 2 compression however, the synchronization between video and EEG has not been standardized.[14] Split screen synchronized video and dual screen review are reported to be useful to evaluate paroxysmal neurological events.[181] Digital video (and audio) are typically encoded into MPEG, MPEG2, or MPEG4 formats differing in the degree of resolution and compression algorithms used, and synchronized with EEG by use of a time marker. 24-hour VEM requires up to 30 GB of memory and varies depending upon video resolution (usually 240 x 320 pixels vs 480 x 640 pixels), degree of coloration, number of frames/second, and machine data compression algorithm employed. Therefore, relevant clips involving event of interest are selected for storage of VEM data to limit memory use.

There were 4 class II studies (2 without EEG and 2 with EEG) that consistently showed benefit with the use of video. The confidence in the evidence of using video with EEG monitoring is moderate.

Recommendation: video should be combined with EEG during the use of LTVEM (strong recommendation).

5.3 Safety

The potential for dangerous consequences exist during LTVEM because patients' seizures are induced.[8] Convulsions and seizure emergencies, falls, injury, and postictal psychosis among others are possible safety risks.[33, 167] Standardized protocols are recommended for use to ensure patient safety.[144, 182] Safety and quality data from 181,823 patients reporting on 34 different safety variables demonstrates a great deal of variation in reporting safety and quality measures in EMUs in a meta-analysis.[47] No validated protocols are universally available and utilized, and substantial variation in practice for essential aspects of LTVEM exist for performing optimal patient observation, tapering ASMs, and ASM rescue protocols.[183-185] Therefore, great variation in quality and safety measures exists during LTVEM. A pooled proportion of adverse events occurred in 5-9% of patients in a meta-analysis.[47] Practice variability was present among 32 epilepsy centers in the UK reflecting differences in patient populations.[167]

5.3.1 Clinical safety

Overall, LTVEM is an acceptably safe procedure with appropriate precautions.[186-188] Safety issues are most frequently encountered for patients undergoing pre-surgical LTVEM.[189] Seizure provocation poses potential safety risks to patients represented by category III and IV studies.[183, 190, 191] Even patients with PNEA are prone to adverse events, usually falls[183] often while in the bathroom.[192] A large category III study of 976 patients found only 1.9% of patients fell (without injury) despite being freely mobile, a similar finding reported in other centers practicing restricted mobility.[193] One study (category III) compared falls in alert patients within the first 3 days of LTVEM (in the bathroom) and hospitalized patients with mental status changes who fell after 3 days (in their rooms).[194] Novel lift systems, patient education, frequent nursing rounds, use of bed alarms, and assistance when out of bed may limit fall risk.[192] A category IV study reviewing records from an Epilepsy Foundation database identified 2/733 patients with aspiration following a GTC seizure, and shoulder dislocation in 8/806 during seizures accounting for an overall risk of <1%.[195] Such serious medical consequences associated with seizures such as malignant cardiac arrhythmias, bony fractures, and pneumonia rarely occur.[187, 191] Prospective comparative studies (category III) show patients with PNEA have increases in heart rate and systolic blood pressure during the ictal phase, potentially predisposing to complications when attacks are severe and prolonged.[196] Ictal asystole has been reported in 0.22–0.4% of patients undergoing LTVEM, and systematic review of 157 cases found females with early-onset epilepsy and preexisting heart conditions, and males with late-onset drug-resistant epilepsy and autonomic dysregulation were predisposed.[197] Sudden unexpected death in epilepsy during LTVEM has been rarely reported as retrospective series (category IV) but involving multiple centers throughout the world.[198, 199]

Current practice recommendations reached consensus agreement to obtain informed consent before VEM. Requiring 24 hour a day observation of patients by nursing and professional staff over the monitoring duration was considered a minimum standard, including alarm systems and direct observation with video monitors.[167] A large, multicenter, category II study of epilepsy centers in the UK investigated staffing as a patient safety outcome recommending a nurse-to-patient ratio in an EMU should not exceed a ratio of 1:4.[200] A category II prospective population-based observational study of patients implanted with invasive EEG electrodes found a risk of intracranial hemorrhage in a significant minority during LTVEM.[201] Nurse-to-patient ratios in an EMU was identified to promote safety but these studies provide low confidence in the evidence.

Recommendation: The safe, maximal patient to nurse ratio may be 1:4 (weak recommendation).

5.3.2 Electrical safety

Category IV clinical reports reflect essential safety features during LTVEM **(Table 4).**[221-225] Electrical safety rules and governance are unique to individual countries and established by the International Electrotechnical Commission. Electrical shocks usually result from chassis leakage current from LTVEM equipment electrically powered from the 120-volt (United States; 110 volts in Europe) power transformers. Electrical injury is possible when current passes through a patient from an electrical source or electrode contacts.[202, 203] Any mains-powered electrical device may “leak” current and enter the patient through direct contact of a nearby metal object or indirectly by capacitive coupling inside an electrical device from nearby wiring. Safe current limits are set for both normal conditions and for single fault conditions (i.e., a disconnected earth ground). LTVEM safety guidelines exist for individual components of LTVEM equipment and are regularly checked for safe use according to hospital standards and biomedical engineering services.[204] Proper grounding of the patient and the EEG recording equipment is critical for avoiding electrical shock risk.

Microshock injury could occur to patients undergoing LTVEM with scalp electrodes if there is a low-resistance pathway into the body such as a pacemaker or saline-filled catheter which can provide a low resistance pathway to the heart.[204] Currents of 5-10A can induce ventricular fibrillation[202] as a function of body habitus, current intensity, duration, and pathway.[203, 205, 206]. Ground loops are critical to avoid during LTVEM. Hazardous currents can be generated from ambient magnetic flux from powerline wiring in walls or ceiling in EEG leads that are too lengthy or widely separated.

There is no evidence for or against methods to ensure electrical safety in patients undergoing VEM. But principles that apply to electrical safety of all hospital devices apply to EEG equipment as well. Grounding safety rules should be followed to prevent patient injury.

5.4 Practice and Personnel

Despite the use of VEM as a gold standard for seizure diagnoses, limited appreciation of this technique is held by some general neurologists, psychiatrists, hospital administrators, and insurance carriers managing people with paroxysmal neurological disorders.[16] The current practice of VEM has been outlined in a European multi-center web-based survey study.[33]

5.4.1 Seizure Monitoring

Considerable variation in the practice and organization of EMUs was found in a web-based survey study involving 25 centers across 22 European countries, with subsequent recommendations to follow evidence-based LTVEM practices.[33] Delayed response to seizure alarms may occur due to high false-positive rates of detection.[207] A retrospective multicenter study found average response time from caregivers was twice as fast as the response by EMU-based personnel.[208] Staff uncovering patients during seizures to assist with evaluation of semiology found 40% of patients were fully or partially obscured for more than 30 seconds during the event compromising visualization.[208] Implementing standardized protocol for managing and testing patients during seizures in the EMU can potentially increase the quality of the data recorded during LTVEM. A task force appointed by the ILAE Commission on European Affairs and the European Epilepsy Monitoring Unit Association prospectively studied (category II) testing paradigms during seizures in 152 consecutive patients (250 seizures) at 10 epilepsy centers with an interictal, ictal, and post-ictal testing paradigm successfully implemented in 93% of patients with seizures, limited only by seizures of short duration.[209] A European survey showed 91% of EMUs performed ictal or postictal testing, however, there was no standardization of the procedure, and many EMUs lacked institutional guidelines for testing patients during seizure monitoring.[144] Retrospective comparative assessment of seizures in 33 adult or pediatric patients captured during LTVEM found behavioral testing during seizures was able to be performed in only 50% of patients whereas automated video-recorded behavioral tasks activated by computer-based seizure detection provided reliable behavioral assessment.[210] One category II study was unable to demonstrate superiority of a particular testing paradigm during VEM. Therefore, the confidence in evidence is low.

Recommendation: A written, standardized protocol may be used in each LTVEM unit for managing and testing patients during seizures (conditional recommendation).

5.4.2 Services

Guidelines for facilities, personnel and essential LTVEM services are established by experts in referral hospitals to comply with national and international standards.[211] Partnerships between epilepsy specialists in full-service epilepsy centers performing LTVEM and referring clinicians should exist to form care networks to continue best practices and follow-up patient management.[16, 212]

5.4.3 Staffing

Patients who undergo diagnostic LTVEM are subject to variable staffing models.[116, 212, 213] Consensus was obtained for some elements involving staffing VEM units by skilled personnel **(Table 5).**

Specialized services such as functional brain mapping by electrical stimulation of invasive electrodes, electrocorticography, evoked potential recording, and investigative drug and device trials complement clinical care and require a high degree of expertise when considering resection or ablation of epileptogenic tissue.[212] Individual qualifications and responsibilities have been outlined for a LTVEM laboratory.[22] Implementing periictal nursing intervention was shown to shorten the duration of postictal generalized EEG suppression but oxygen administration did not in a retrospective (category III) study.[214] A national survey report in the UK recommended dedicating healthcare professionals in LTVEM units in charge of patient supervision should target one nurse for 4 patients or less as optimal[167] similar to an optimal ratio of technologists to patients monitored. Patient companions during LTVEM help document events, test awareness, ensure visualization of the patient on video, and alert staff at seizure onset. Immediate family members are often more helpful than non-family members.[215]

Qualified EEG technologists and monitoring technicians are key members of the team during LTVEM to recognize events and interact with nursing staff and provide feedback during seizure monitoring. A survey study in the United States found 68.8% of participants provided continuous patient observation during LTVEM.[191] A European survey study reported 80% of participants provided continuous observation with 10% only during daytime hours of operation and 10% performing observation intermittently in conjunction with automated seizure and spike detection algorithms.[144]

5.4.4 Duration of Recording

Wide variability exists among epilepsy centers regarding the duration of VEM.[216] The duration of EMU admission for VEM depends upon the reason for admission.[217] One comparative trial (category III) in 226 patients found most patients undiagnosed following outpatient EEG received a definitive diagnosis in less than 1 day of VEM.[218] Other prospective studies (category III) required a second day of VEM[219] and others were nearly equal between 1-2 days.[76] In contrast, a retrospective (category IV) study of 439 LTVEM cases found 72 hours was able to record at least one seizure in 90% of patients with epilepsy (vs 48 hours for those with PNEA).[122] One retrospective study (category IV) 5 days of LTVEM reported a 98% recovery rate for the targeted clinical event.[76]

Studies (category III and IV) in patients with PNEA confirmed by short-term VEM suggest LTVEM could be obviated when events are captured.[129, 220] Facilities may be unavailable or inaccessible in remote regions and developing countries.[221] A recent prospective observational study in India (category III) correctly diagnosed about 80% of PNEA cases with short-term LTVEM.[222] However, shorter initial duration of LTVEM show higher risk for patient readmission in a large retrospective single center cohort comprised of 865 patients and 30-day encounters with a readmission rate of 7.0%.[223] Overall, the optimal duration for LTVEM appears to be more than 3 days for patients with drug-resistant epilepsy and those with PNEA are typically diagnosed in less than 2 days.[224] Retrospective studies show IEDs in the EEG appeared soon after sleep in more than 90% of patients with focal and generalized epilepsies.[225] In a retrospective (category III) study of 596 admissions, nearly 40% of epilepsy patients had longer LTVEM durations compared to those with PNEA with the need to record additional seizures as the primary reason for extended stays.[217] For surgery, at least 3 seizures are generally representative in uncomplicated cases though higher number of seizures may be required when more than one epileptogenic zone is suspect. In bitemporal epilepsy patients implanted with a responsive neurostimulator, the average time to record the first electrographic seizure from a contralateral focus was 41.6 days[226] in a retrospective review (category III) evaluating the electrocorticogram. A large retrospective (category III) study of 1000 children (mean 7 years) monitored over 1.5 days (r= 1-10) found longer sessions were associated with significantly higher rates of ILAE classification of epilepsies and lower rates of inconclusive session. Hence in adolescents LTVEM was recommended for 3 days or more when events are less than daily.[227] Because the duration of LTVEM depends on the indication and on seizure frequency, the duration of LTVEM is variable and based upon the endpoint of recording.

Recommendation: The duration of LTVEM will vary relative to the indication for performance and number of seizures and events captured (conditional recommendation).

5.4.5 Activation

Activation protocols provide relative degrees of usefulness in patients with epilepsy.[228] Two prospective multicenter studies (category II) support safety and efficacy of activation procedures during EEG.[229, 230] In addition to hyperventilation and photic stimulation, sleep deprivation is recommended in guidelines to elicit abnormalities.[139, 143, 231] In addition, exercise, stress, and dietary influences may precipitate seizures in some patients with epilepsy.[232, 233] A random sample of 1000 standard EEGs in the UK validated the additive effect of activation to standard EEG in 11% of cases.[234] In patients with epilepsy, standard EEG from category II and III studies demonstrate sleep as a potent form of activation to trigger seizures and IEDs.[169, 235] Sleep-deprivation during LTVEM has diagnostic value in activating IEDs,[236, 237] and an acceptable practice in the United States and Europe[139, 238] to increase the yield[239, 240] despite a lack of systematic analyses. The ACNS, ILAE, and NICE all recommend that HV is performed as part of a standard EEG.[242] Hyperventilation with breath counting and intermittent photic stimulation are useful in patients with GGE to clarify epilepsy syndromes.[62] A prospective study (category I) of 52 seizures recorded over 247 days of LTVEM demonstrated the rate of activated seizures was nine times higher than the rate of control seizures and demonstrated value of instituting repeated hyperventilation as an activation technique combined with ASM withdrawal.[241] One category II study found usefulness of hyperventilation to activate 25% of patients with temporal lobe seizures during LTVEM.[242] Unique methods of activation during LTVEM may provoke seizures in some patients with reflex epilepsies using individualized stimuli including reading, writing, eating, performing arithmetic, and somatosensory stimulation.[235, 243]

In the diagnosis of PNEA, there is marked methodological heterogeneity in activating techniques and low level of evidence in a systematic review including 11 prospective studies.[244] Activation techniques expedited the goal of achieving event recording to diagnose patients with PNEA in a randomized controlled trial using simple suggestion techniques during LTVEM[41] , either alone[229, 230] or in combination with photic stimulation[129] to provide evidence of suggestibility.[245] Temple compression and tuning fork application were found in a retrospective (category IV) study to be most effective.[246] However, controversy exists regarding ethical use of activation in PNEA.[39, 247-249] Sensitivity range from of 77- 84%[250-253] and specificity approaches 100%[250] for diagnosis. In older comparative trials (category III and IV), using placebo (e.g., saline injection, application of color patches, alcohol patches or tuning fork etc.) elicited PNEA in most patients.[251] Atypical events or epileptic seizures can occur in a minority resulting in an incorrect diagnosis.[250] Provocation without placebo such as combined hyperventilation and photic stimulation may be favorable due to its comparable sensitivity to other placebos without perceived deception given it's routine use in standard EEG,[252] non-inferiority,[254] with the potential to shorten LTVEM and reduced costs by expediting the diagnosis for patients with infrequent events.[255]

There is moderate confidence in evidence that hyperventilation was successful in conjunction with ASM withdrawal as an activating procedure to provoke seizures in patients with GGE and low evidence in PNEA with expert-opinion suggesting patient-specific provocation methods may be performed in patients with reflex epilepsies.

Recommendation: patients with GGE should undergo hyperventilation in conjunction with ASM withdrawal as an effective activating procedure (strong recommendation).

5.4.6 Drug reduction

ASM is routinely reduced during LTVEM to increase the likelihood of event capture. A judicious speed of ASM reduction should be balanced against ineffective or prolonged hospitalization for LTVEM.[122] Current practices of ASM reduction are highly variable across epilepsy centers performing LTVEM. Rapid withdrawal may potentially obscure localizing information at seizure onset in the EEG during LTVEM in patients with drug-resistant epilepsy.[33, 256] Introducing a scheduled taper of ASM according to a pre-prescribed protocol facilitates a standardized approach to safe seizure provocation.[182] However, no standardized protocols for reduction of ASM during LTVEM exist[257] and current practices are highly variable across centers.[184] Overly aggressive ASM taper may result in capturing non-habitual seizure semiology, obscure localizing information on ictal EEG, or produce seizure clustering and status epilepticus. Formal protocols focused on ASM taper were shown to have fewer seizure clusters during LTVEM.[258] Various study methodologies and small sample sizes have limited reliable conclusions to recommend the optimal rate of ASM taper during VEM.[259] In a comparative study (level II) ictal EEG localization did not change during ASM withdrawal during reduction of lamotrigine and carbamazepine during LTVEM performed during pre-surgical evaluation.[260] Two prospective studies have provided high level evidence for the withdrawal of ASM during LTVEM.[261, 262] One randomized controlled (category I) trial using open-label but blinded outcome assessed ASM reduction in 2 arms of 70 patients each, comparing fast taper by 30–50% (fast) and slow taper by 15-30%, in patients without a prior history of status epilepticus or frequent daily seizures and concluded fast taper of ASMs was safe and effective aside from an increase in 4-hour seizure clusters.[261] A second prospective study of 158 patients with no control arm (Category II) found rapid taper of ASM combined with sleep deprivation during LTVEM was safe and effective in adults relative to time of first seizure resulting in reduced time spent in the EMU.[262] This compares favorably with other retrospective, single-center, observational studies.[263] In contrast, rapid ASM tapering within one day was associated with longer EMU admissions and greater seizure frequency during LTVEM.[122] Rapid ASM taper in a category III study did not produce a significant adverse effect on the ECG or heart rate variability.[264] Tapering carbamazepine was found to influence ictal semiology intensifying seizure frequency and severity compared to valproate in a category III study.[265] In category IV studies involving barbiturates and benzodiazepines, taper triggered seizures in some people without epilepsy.[266] Patients completely discontinued from ASM appear more likely to experience focal to bilateral tonic-clonic seizures than those in whom ASM were partly discontinued.[267] Slowly tapering ASM at home prior to inpatient LTVEM starting a week or more prior to admission has been reported to be safe in a retrospective observational cohort of 273 patients (category III) without complications.[268]

In patients without a prior history of status epilepticus or frequent daily seizures, ASM taper by 30–50% (fast) and slow taper by 15-30% was safe.

Recommendation: in patients without a history of status epilepticus or frequent daily seizures a taper of 30-50% daily should be considered (strong recommendation).

5.4.7 Automated Analyses

Automated analyses used to identify IEDs and electrographic seizures attempt to condense and reduce the large volume of data requiring physician review[269] to facilitate time-efficient interpretation. Relying solely on automation alone is not recommended without EEG review by a qualified human interpreter to limit overestimating abnormality. Commercially available automated software is used to detect and validate epileptiform activity, classify, and quantify EEG abnormalities.[270] However, while even better performance is likely to be encountered, human validation will be required. Software systems available for seizure detection have been tested in a prospective multi-center study[271] and retrospectively.[271-273] Algorithms for automated seizure detection during scalp LTVEM have a greater sensitivity than IED detection and may exceed 75.0% detection with low false positive rate[274] to supplement patient and witness identified seizures. In a study of 159 patients with temporal lobe epilepsy, 794 focal seizures were analyzed with a sensitivity of 87.3% and 0.22 false detections per hour.[275] However, this has not been confirmed in extratemporal seizures or generalized seizures of a short duration (e.g. epileptic spasms). In a recent study of the performance of the Persyst 14 seizure detection algorithm in prolonged EEGs from 120 patients, the performance of the system was comparable to three human experts and had a sensitivity of 78% and a false positive rate of 1 per day.[273] Most commercially available systems will only identify a seizure if the ictal EEG changes have a minimum duration of at least 12 seconds. Automated analyses for seizure detection is estimated to save 1.3 hospital days per patient admission, based on the percentage of seizure detections captured solely by the computer.[276]

Recommendation: Automated algorithms for spike and seizure detection may provide complementary aid to expert assessment (weak recommendation).

5.4.8 Rescue Medication

The best seizure response occurs with preparation and when a protocol is in place for seizure urgencies and emergencies.[16] Prolonged seizures, acute repetitive seizures, and rarely status epilepticus may result during VEM.[277] Implementing safety strategies result in a clinically relevant reduction of adverse events.[278] Fortunately, serious consequences and adverse events are rare when slow reduction of ASM is used with a benzodiazepine rescue protocol.[259] In children and adults, class 1 evidence demonstrates both intravenous lorazepam and intravenous diazepam are efficacious as initial therapy in convulsive status epilepticus, though other ASM and routes of administration have proven similar efficacy.[279, 280] A retrospective VEM study (category III) found duration differed with focal and generalized seizures guiding the use of rescue medication.[281] No universal approach or standardized protocol exists for use of rescue medications during LTVEM in the EMU.[282] A useful protocol as part of the admission order set should contain personalized orders, treatment parameters, and when the physician is to be notified for prolonged or frequent seizures. The National Association of Epilepsy Centers recommends standing orders for both IV and non-IV emergency ASM to be used for seizures lasting more than 5 minutes.[283] When to administer rescue ASM is center-specific and relative to seizure type and duration. A GTC seizure lasting 3 minutes or focal impaired awareness seizure lasting 5-10 minutes should prompt consideration of rescue ASM. More than one GTC seizure per 24 hours or more than 2 focal impaired awareness seizures in 12 hours also merits consideration.

5.5 Reporting

The VEM report has traditionally been a qualitative descriptions of waveform interpretation for VEM sessions using free text formats. The VEM report should include introductory demographic information regarding the patient and conditions of recording, a description of essential waveform characteristics, an assessment of normal or abnormal, and a clinical correlation in response to the clinical question posed prior to VEM.[143, 196, 209] VEM interpretative reports, like standard EEG, are becoming increasingly automated.[209] Providing graphic display of EEG samples[28] enhance reproducibility of interictal and ictal EEG portions of the VEM report to facilitate patient management and clinical research.[284] Updated terminology[59, 174] and newer classification systems[104] provide current framework of the report. Despite established American guidelines[28] and European consensus,[285] significant variation in observing guidelines for standard EEG reporting exist.[286] Moderate interobserver reliability plagues EEG interpretation which may be in part due to inconsistencies and lack of standardization for reporting style and terminology utilized.[24, 285, 287] In 2017, the second International version of SCORE (Standardized computer-based organized reporting of EEG) initially published as a European consensus established a template for reporting and endorsed by the IFCN as a guideline based upon adaptation from IFCN, ILAE, and ACNS classification and glossary of terms to enhance the initial European version.[285] The consequences of incomplete, inadequate, or false VEM reporting lies in the potential for initiating or continuing inappropriate treatment. Instituting electronic databases with a list of pre-established terms may result in higher inter-rater agreement of EEG features.[285, 288, 289] Minimum standards are recommended when forming a LTVEM report. The final diagnosis should include the type of epileptic, nonepileptic, or unclassified event recorded. Seizure types should be specified according to ILAE terminology. For diagnostic reporting, both semiology and EEG recorded during seizure should follow a chronological order using standardized terminology (IFCN Glossary for EEG; ILAE Glossary for semiology). Patient information, conditions of recording, description of the recording and significant features, an impression (normal or abnormal), diagnostic significant and clinical correlation should be included. Detailing the electroclinical description of significant features during presurgical evaluation should specify lateralizing and localizing features for identification of the symptomatogenic zone at a minimum.

6. Conclusions

Significant gaps in evidence exist due to substantial heterogeneity, narrow spectrum conclusions, and limited high-level evidence across published national and international studies on selected features of LTVEM. This clinical practice guideline provides a comprehensive synthesis of the standards for LTVEM in people with epilepsy and provides recommendations using GRADE to implement standardize approaches to selected aspects of its use **(Table 6).** This does not preclude the numerous reports, national and international guidelines, and position statements from providing guidance to perform LTVEM. Experience gained from selective aspects of VEM provides important insight into conducting comprehensive high-level studies in areas with limited information and points the way for further clinical research development.

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Figure Legends

Figure: PRISMA diagram of the systematic literature search and breakdown of peer-reviewed journals selected for evaluation.

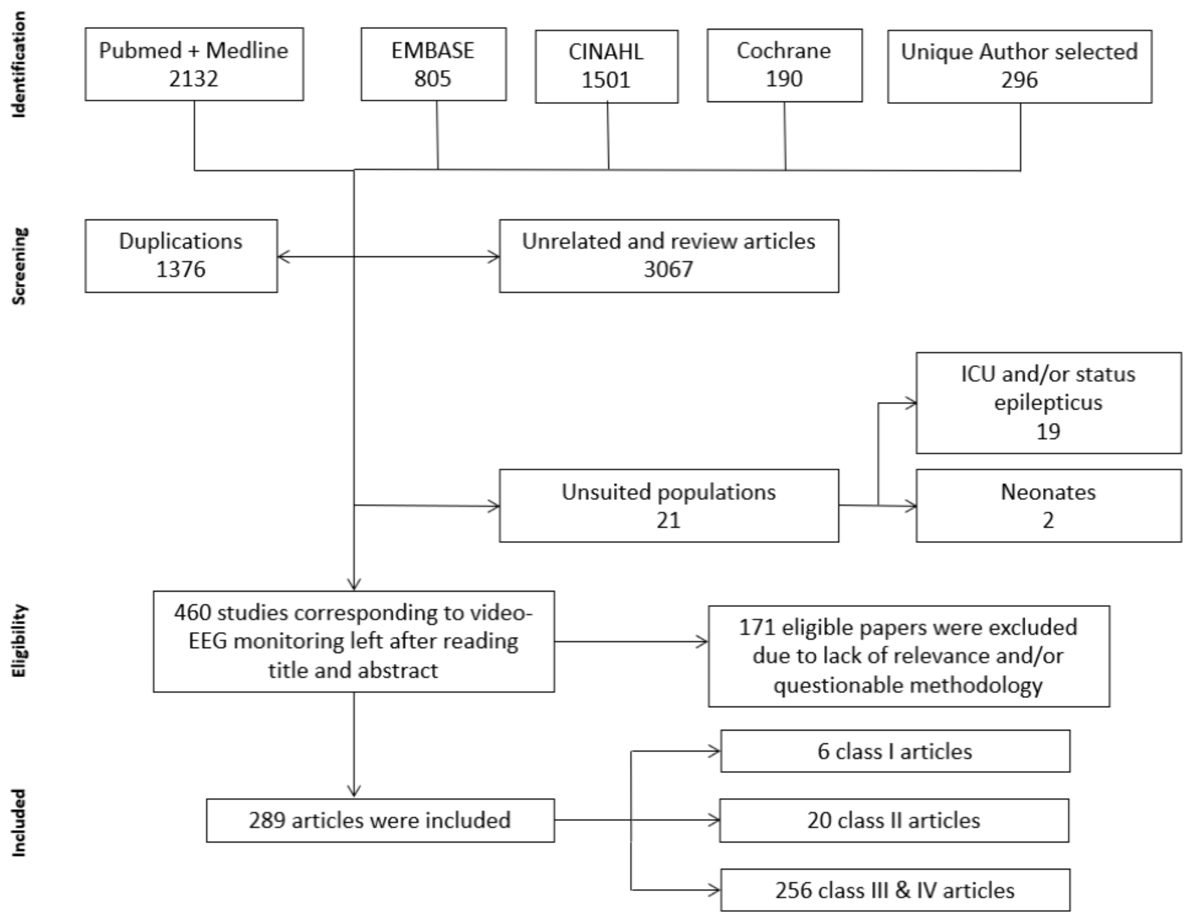

Table Legends

Table 1: Category 1 and 2 manuscripts addressing selected components of the minimal standards for LTVEM.

Table 1

Author and Year	Class	Aspect of VEM	No. of Patients (MvsF)	Age Range (mean)	Prospective/ Retrospective	Control	Randomization	Comparison Arm	Single/ Multicenter	Type of Seizures
Dwivedi et al, 2017	1	Diagnosis	116 (57 vs 59)	0.8-17 (9.0;10.0)	Prospective	YES	YES	YES	Single	Focal and Generalized
Engel et al., 2012	1	Diagnosis	23	Not specified (34.3)	Prospective	YES	YES	YES	Multicenter	Focal (TLE)
Wiebe et al., 2001	1	Diagnosis	80 (40 vs 40)	Not specified (34.4;35.5)	Prospective	YES	YES	NO	Single	Focal (TLE)
Jonas et al., 2011	1	Hyperventilation	80 (39vs41)	7-77 years (32)	Prospective	NO	NO	YES	Single	Focal and Generalized
Kumar et al., 2018	1	Withdrawl of AED	140 (88 vs 52)	2-80 years (20.3)	Prospective	YES	YES	NO	Single	Focal and Generalized
Lancman et al., 1994	1	Activation	93	6-53 years (26.7)	Prospective	YES	NO	YES	Single	PNEA
Koutroumanidis et al., 2008	2	Classification	33 (15v18)	7-44 (20) ; 13-56 (24.3)	Prospective	NO	NO	NO	Single	Generalized
Kandler et al, 2013	2	Safety	Not specified	Not specified	Prospective	NO	NO	NO	Multicenter	Focal and Generalized
Hedegard et al., 2014	2	ICM Complications	Not specified	2-58 years (26)	Prospective	NO	NO	YES	Single	Not specified
De Marchi et al., 2017	2	Safety and efficiacy	113 (35v78)	10 to 70 years (24.9)	Prospective	NO	NO	NO	Single	Generalized
Craciun L et al., 2017	2	Safety	976 (428vs528)	1- 80 years (24.57)	Prospective	NO	NO	NO	Single	Not specified
Guaranha et al., 2009	2	Activation	76 (35 vs 41)	12–53 years (24.3)	Prospective	NO	NO	NO	Single	Generalized
McGonigal et al., 2002	2	Yield of VEM	30 (8vs22)	Over 16 years	Prospective	YES	YES	NO	Single	PNEA
Walczak et al., 1994	2	Utility and reliability	68	Not specifed	Prospective	NO	NO	YES	Single	PNEA
Chen et al., 2011	2	Induction	51 (42 vs 9)	No range(12.56; 11.26; 17.78)	Prospective	NO	NO	YES	Single	PNEA
Rizvi et al., 2014	2	Safety	158 (83 vs 75)	Not specified (37.2)	Prospective	NO	NO	NO	Single	Focal and Generalized
Furbass et al., 2015	2	Automatic Detection	205	Not specifed	Prospective	NO	NO	YES	Multicenter	Not specified
Salinsky et al., 1997	2	Automatic Detection	72	11-56 years (32.4)	Prospective	NO	NO	NO	Single	Not specified
Benbadis et al., 2001	2	Classification	78	Not specified	Prospective	NO	NO	YES	Multicenter	Focal and Generalized
Lee et al., 2009	2	Diagnosis and Management	129 (72 vs 57)	7-89 years (38.3)	Prospective	NO	NO	YES	Single	Epileptic and PNEA
Goyal et al., 2014	2	Induction	190 (73 vs 117)	No range(21.38; 21.08)	Prospective	YES	NO	YES	Single	Epileptic and PNEA
Baheti et al, 2011	2	Utility and reliability	148	No range(51.3)	Prospective	NO	NO	NO	Single	Epileptic and PNEA
Kane et al, 2014	2	Hyperventilation	3170	0.25-97 (33.1)	Prospective	NO	NO	YES	Multicenter	Epileptic and PNEA
Yogarajah et al, 2009	2	Duration	612	No range (36)	Retrospective	NO	NO	YES	Single	Epileptic and PNEA
Jedrzejczak et al, 1999	2	Diagnosis	1083	Not specified	Retrospective	YES	NO	YES	Single	Epileptic and PNEA
Alving et al, 2009	2	Diagnosis and Duration	234	0.6-80(30)	Retrospective	NO	NO	YES	Single	Epileptic and PNEA

Table 2: PICO questions ascertaining population, intervention, comparator cohorts, and outcome questions addressing indications, technical requirements, and performance in practice of LTVEM.

Table 2

Population	Children and adults with seizures with intensive need for diagnosis, classification/quantification, or to characterize refractory seizures for surgery
Intervention	Video-EEG monitoring lasting for more than 24 hours
Comparator	Historical diagnosis and site of surgery
Outcome	Event cessation in non-epileptic attacks, seizure reduction or seizure freedom, usefulness

Table 3: Summary of Technical Parameters Reached in Majority Using Modified Delphi Method.

Table 3	
VEM Technical Feature	Majority Response
Disc electrodes applied individually for diagnostic scalp based VEM	Yes
Intracranial monitoring electrodes (all types but foramen ovale)	Yes
Basal temporal additional electrodes	Yes
Nasopharyngeal or sphenoidal additional electrodes	No
10-10 system application	Yes
Source localization software recommended (surgical VEM)	Yes
Minimal number of electrodes for VEM	>21
Use of EKG	Yes
Use of oximetry, extra-occulogram, polygraphy	Optional

Table 4: Electrical safety guidelines for VEM equipment. Adapted from Burgess RC. Electrical Safety. Chapter 5. In: Handbook of Clinical Neurology, K.H. Levin and P. Chauvel, Editors. Vol. 160 (3rd series) Clinical Neurophysiology: Basis and Technical Aspects. 2019:67-81.).

Table 4	
VEM	Recommendations
Power source	• Use approved three-pronged plugs, receptacles, and power cords for electrical devices. • Patients should be connected in each EMU room to a single cluster of power receptacles. • Banks of electrical receptacles should be located together near the head of the bed.
Patient room	• Move dual-wired devices away from patients and avoid metal contact with the bed. • Educate EMU and nursing staff to avoid connections between the patient and ground. • Do not touch metal objects and the patient at the same time to avoid electrical connection.
Grounding	• Do not connect the patient to earth ground. • Only use equipment with an isoground connection to the patient. • Periodically test electrical equipment for current leakage (cable current should be <10 mA).
Electrical equipment	• Turn equipment on before patient connection/disconnect before turning equipment off. • Do not use extension cords. • Employ battery-operated equipment where possible.
Patient	• Recording electrodes should not be connected to building ground, only through isoground.
Stimulation	• The cardiac area should not be within the stimulating field. • For electrical stimulation studies, do not exceed intensity or duration recommendations. • The stimulus delivery subsystem should be entirely isolated from the building ground.
Equipment testing	• Equipment should be checked for compliance with hospital safety standards and biomedical services. • A sticker should be placed to attest equipment safety (and date). • Testing at regular intervals by biomedical engineering should determine electrical safety and include visual inspection of power cords, plugs and grounds, wiring, and room wall receptacles. • Measurements of ground pin contact tension should not be > 10 oz, chassis leakage current should normally be < 100mA, and leakage current from each terminal should be < 20mA.

Table 5: Summary of Personnel Responsibilities Reached in Majority Using Modified Delphi Method.

Table 5	
Personnel	Majority Response
Board certification for physicians performing VEM	Yes
Epileptologist preferred	Yes
Use of a dedicated hospital area for VEM	Yes
Designated EMU	Yes
Solo NP/PA patient care	No
Solo resident patient care	No
Registered technologists performing VEM	Yes
Electrodes require measuring and marking (scalp EEG)	Yes
VEM physician coverage	24 hours/day
Optimal number of technologists per patient	2:1
Archiving: segments selected by technologists/residents	Yes
Review entire VEM file before EEG report is finalized	Yes
Review entire video clips before EEG report is finalized	Yes

Table 6: Summary of GRADE recommendations for selected features of LTVEM based upon high-level evidence.

Table 6										
Intervention	Outcome*	Highest level studies	Precision	Consistency	Directness	Plausible	Magnitude of Effect	Dose Response	Confidence in Evidence	Strength of recommendation
LTVEM	Differentiating epileptic from non-epileptic	6 Category II	-	D	-	-	U	-	moderate	strong
LTVEM	Classifying epilepsy	1 Category II	-	-	-	-	-	-	low	weak
LTVEM	Quantifying numbers of seizures	Multiple category III	-	D	-	-	-	-	low	weak
LTVEM	evaluation of presurgical temporal lobe epilepsy	3 Category I	-	-	-	-	U	-	high	strong
LTVEM	evalution of presurgical extra-temporal lobe epilepsy	Multiple category IV	-	-	-	-	-	-	very low	none
LTVEM with video	diagnostic yield	4 Category II	-	-	-	-	-	-	moderate	strong
Nurse:patient ratio	patient safety	1 Caegory II	-	-	-	-	U	-	moderate	strong
Standardized protocol	evaluation of seizures	1 Category II	-	-	-	-	-	-	low	weak
LTVEM length	type of seizures, localization of seizure onset	2 Category III	-	-	-	-	-	-	low	weak
Activation	eliciting seizures	1 Category I	-	-	-	-	-	-	moderate	strong
Medication reduction	eliciting seizures without status	1 Category I	-	-	-	-	-	D	moderate	strong
Automated detection	spikes and seizures	2 Category III	-	-	-	-	-	-	low	weak

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Conflicts of interest

Sandor Beniczky has nothing to disclose.

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References

1. England, M.J., C.T. Liverman, A.M. Schultz, and L.M. Strawbridge, *Summary: a reprint from epilepsy across the spectrum: promoting health and understanding.* Epilepsy Curr, 2012. **12**(6): p. 245-53.
2. Perucca, E., A. Covanis, and T. Dua, *Commentary: Epilepsy is a Global Problem.* Epilepsia, 2014. **55**(9): p. 1326-8.
3. Thijs RD, Surges R, O'Brien TJ, Sander JW. Epilepsy in adults. The Lancet. 2019. 393(10172): p. 689-701.
4. Feigin, V.L., E. Nichols, T. Alam, et al., *Global, regional, and national burden of neurological disorders, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016.* The Lancet Neurology, 2019. **18**(5): p. 459-480.
5. Fisher, R.S., C. Acevedo, A. Arzimanoglou, et al., *ILAE official report: a practical clinical definition of epilepsy.* Epilepsia, 2014. **55**(4): p. 475-82.
6. Kwan, P. and M.J. Brodie, *Early identification of refractory epilepsy.* New England Journal of Medicine, 2000. **342**(5): p. 314-319.
7. Merrell, R.T., S.K. Anderson, F.B. Meyer, and D.H. Lachance, *Seizures in patients with glioma treated with phenytoin and levetiracetam.* Journal of neurosurgery, 2010. **113**(6): p. 1176-1181.
8. NICE, *The diagnosis and care of children and adults with epilepsy*. 2004, NICE.
9. Network, S.I.G., *Diagnosis and management of epilepsy in adults.* SIGN, 2003. **70**.
10. Singapore, M.o.H., *Diagnosis and Management of Epilepsy in Adults*. 2007.
11. Tatum, W.O., G. Rubboli, P.W. Kaplan, et al., *Clinical utility of EEG in diagnosing and monitoring epilepsy in adults.* Clin Neurophysiol, 2018. **129**(5): p. 1056-1082.
12. Rugg-Gunn, F., N. Harrison, and J. Duncan, *Evaluation of the accuracy of seizure descriptions by the relatives of patients with epilepsy.* Epilepsy research, 2001. **43**(3): p. 193-199.
13. Deacon, C., S. Wiebe, W. Blume, et al., *Seizure identification by clinical description in temporal lobe epilepsy: how accurate are we?* Neurology, 2003. **61**(12): p. 1686-1689.
14. Velis, D., P. Plouin, J. Gotman, et al., *Recommendations regarding the requirements and applications for long-term recordings in epilepsy.* Epilepsia, 2007. **48**(2): p. 379-84.
15. Eddy, C.M. and A.E. Cavanna, *Video-electroencephalography investigation of ictal alterations of consciousness in epilepsy and nonepileptic attack disorder: Practical considerations.* Epilepsy & Behavior, 2014. **30**: p. 24-27.
16. Shih, J.J., N.B. Fountain, S.T. Herman, et al., *Indications and methodology for video-electroencephalographic studies in the epilepsy monitoring unit.* Epilepsia, 2018. **59**(1): p. 27-36.
17. Ghougassian, D.F., W. d'Souza, M.J. Cook, and T.J. O'Brien, *Evaluating the utility of inpatient video-EEG monitoring.* Epilepsia, 2004. **45**(8): p. 928-32.
18. Kumar-Pelayo, M., M. Oller-Cramsie, N. Mihu, and C. Harden, *Utility of video-EEG monitoring in a tertiary care epilepsy center.* Epilepsy Behav, 2013. **28**(3): p. 501-3.
19. McBride, A.E., T.T. Shih, and L.J. Hirsch, *Video-EEG monitoring in the elderly: a review of 94 patients.* Epilepsia, 2002. **43**(2): p. 165-9.
20. Nordli, D.R., Jr., *Usefulness of video-EEG monitoring.* Epilepsia, 2006. **47 Suppl 1**: p. 26-30.
21. Fitzsimons, M., G. Browne, J. Kirker, and H. Staunton, *An international survey of long-term video/EEG services.* J Clin Neurophysiol, 2000. **17**(1): p. 59-67.
22. American Clinical Neurophysiology, S., *Guideline twelve: guidelines for long-term monitoring for epilepsy.* J Clin Neurophysiol, 2008. **25**(3): p. 170-80.

23. Pressler, R.M., S. Seri, N. Kane, et al., *Consensus-based guidelines for Video EEG monitoring in the pre-surgical evaluation of children with epilepsy in the UK.* Seizure, 2017. **50**: p. 6-11.
24. Scheffer, I.E., S. Berkovic, G. Capovilla, et al., *ILAE classification of the epilepsies: Position paper of the ILAE Commission for Classification and Terminology.* Epilepsia, 2017. **58**(4): p. 512-521.
25. Seeck, M., L. Koessler, T. Bast, et al., *The standardized EEG electrode array of the IFCN.* Clin Neurophysiol, 2017. **128**(10): p. 2070-2077.
26. Moher, D., A. Liberati, J. Tetzlaff, and D.G. Altman, *Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement.* Int J Surg, 2010. **8**(5): p. 336-341.
27. Gronseth, G.S., L.M. Woodroffe, and T.S. Getchius, *Clinical practice guideline process manual.* St. Paul, MN: American Academy of Neurology, 2011.
28. Tatum IV, W.O., O. Selioutski, J.G. Ochoa, et al., *American clinical neurophysiology society guideline 7: guidelines for EEG reporting.* The Neurodiagnostic Journal, 2016. **56**(4): p. 285-293.
29. Bossuyt, P.M., J.B. Reitsma, D.E. Bruns, et al., *Towards complete and accurate reporting of studies of diagnostic accuracy: the STARD initiative.* Radiology, 2003. **226**(1): p. 24-28.
30. Bossuyt, P.M., J.B. Reitsma, D.E. Bruns, et al., *STARD 2015: an updated list of essential items for reporting diagnostic accuracy studies.* Clinical chemistry, 2015. **61**(12): p. 1446-1452.
31. Sauro, K.M., S. Wiebe, E. Perucca, et al., *Developing clinical practice guidelines for epilepsy: A report from the ILAE Epilepsy Guidelines Working Group.* Epilepsia, 2015. **56**(12): p. 1859-1869.
32. Linstone, H.A. and M. Turoff, *The delphi method*. 1975: Addison-Wesley Reading, MA.
33. Kobulashvili, T., J. Höfler, J. Dobesberger, et al., *Current practices in long-term video-EEG monitoring services: A survey among partners of the E-PILEPSY pilot network of reference for refractory epilepsy and epilepsy surgery.* Seizure, 2016. **38**: p. 38-45.
34. Baheti, N.N., A. Radhakrishnan, and K. Radhakrishnan, *A critical appraisal on the utility of long-term video-EEG monitoring in older adults.* Epilepsy research, 2011. **97**(1-2): p. 12-19.
35. Alving, J. and S. Beniczky, *Diagnostic usefulness and duration of the inpatient long-term video-EEG monitoring: findings in patients extensively investigated before the monitoring.* Seizure, 2009. **18**(7): p. 470-473.
36. Yogarajah, M., H.R. Powell, D. Heaney, et al., *Long term monitoring in refractory epilepsy: the Gowers Unit experience.* Journal of Neurology, Neurosurgery & Psychiatry, 2009. **80**(3): p. 305-310.
37. Alsaadi, T.M., C. Thieman, A. Shatzel, and S. Farias, *Video-EEG telemetry can be a crucial tool for neurologists experienced in epilepsy when diagnosing seizure disorders.* Seizure, 2004. **13**(1): p. 32-34.
38. Jędrzegczak, J., K. Owczarek, and J. Majkowski, *Psychogenic pseudoepileptic seizures: clinical and electroencephalogram (EEG) video-tape recordings.* European journal of neurology, 1999. **6**(4): p. 473-479.
39. Benbadis, S.R., W. LaFrance, G. Papandonatos, et al., *Interrater reliability of EEG-video monitoring.* Neurology, 2009. **73**(11): p. 843-846.
40. Benbadis, S.R., P. Thomas, and G. Pontone, *A prospective comparison between two seizure classifications.* Seizure, 2001. **10**(4): p. 247-249.
41. McGonigal, A., M. Oto, A. Russell, et al., *Outpatient video EEG recording in the diagnosis of non-epileptic seizures: a randomised controlled trial of simple suggestion techniques.* Journal of Neurology, Neurosurgery & Psychiatry, 2002. **72**(4): p. 549-551.
42. Hubsch, C., C. Baumann, C. Hingray, et al., *Clinical classification of psychogenic non-epileptic seizures based on video-EEG analysis and automatic clustering.* Journal of Neurology, Neurosurgery & Psychiatry, 2011. **82**(9): p. 955-960.
43. Benbadis, S.R. and W.O. Tatum, *Overintepretation of EEGs and misdiagnosis of epilepsy.* Journal of clinical neurophysiology, 2003. **20**(1): p. 42-44.

44. Benbadis, S.R., *Errors in EEGs and the misdiagnosis of epilepsy: importance, causes, consequences, and proposed remedies.* Epilepsy & Behavior, 2007. **11**(3): p. 257-262.
45. Krauss, G., A. Abdallah, R. Lesser, et al., *Clinical and EEG features of patients with EEG wicket rhythms misdiagnosed with epilepsy.* Neurology, 2005. **64**(11): p. 1879-1883.
46. Benbadis, S.R. and K. Lin, *Errors in EEG interpretation and misdiagnosis of epilepsy.* European neurology, 2008. **59**(5): p. 267-271.
47. Sauro, K.M., N. Wiebe, S. Macrodimitris, et al., *Quality and safety in adult epilepsy monitoring units: A systematic review and meta-analysis.* Epilepsia, 2016. **57**(11): p. 1754-1770.
48. Asadi-Pooya, A.A., J. Tinker, and E. Fletman, *Semiological classification of psychogenic nonepileptic seizures.* Epilepsy & Behavior, 2016. **64**: p. 1-3.
49. Chadwick, D. and D. Smith, *The misdiagnosis of epilepsy: The rate of misdiagnosis and wide treatment choices are arguments for specialist care of epilepsy*. 2002, British Medical Journal Publishing Group.
50. Binnie, C., A. Rowan, J. Overweg, et al., *Telemetric EEG and video monitoring in epilepsy.* Neurology, 1981. **31**(3): p. 298-298.
51. LaFrance Jr, W.C., G.A. Baker, R. Duncan, et al., *Minimum requirements for the diagnosis of psychogenic nonepileptic seizures: a staged approach: a report from the International League Against Epilepsy Nonepileptic Seizures Task Force.* Epilepsia, 2013. **54**(11): p. 2005-2018.
52. Raymond, A., W. Gilmore, C. Scott, et al., *Video-EEG telemetry: apparent manifestation of both epileptic and non-epileptic attacks causing potential diagnostic pitfalls.* Epileptic disorders, 1999. **1**(2): p. 101-6.
53. Dworetzky, B.A., K.A. Mortati, A.O. Rossetti, et al., *Clinical characteristics of psychogenic nonepileptic seizure status in the long-term monitoring unit.* Epilepsy & Behavior, 2006. **9**(2): p. 335-338.
54. Cuthill, F.M. and C.A. Espie, *Sensitivity and specificity of procedures for the differential diagnosis of epileptic and non-epileptic seizures: a systematic review.* Seizure, 2005. **14**(5): p. 293-303.
55. Knox, A., R. Arya, P.S. Horn, and K. Holland, *The Diagnostic Accuracy of Video Electroencephalography Without Event Capture.* Pediatric neurology, 2018. **79**: p. 8-13.
56. Arain, A.M., Y. Song, N. Bangalore-Vittal, et al., *Long term video/EEG prevents unnecessary vagus nerve stimulator implantation in patients with psychogenic nonepileptic seizures.* Epilepsy & Behavior, 2011. **21**(4): p. 364-366.
57. Penry, J.K., R.J. Porter, and R. Dreifuss, *Simultaneous recording of absence seizures with video tape and electroencephalography. A study of 374 seizures in 48 patients.* Brain: a journal of neurology, 1975. **98**(3): p. 427-440.
58. Engel Jr, J., *Report of the ILAE classification core group.* Epilepsia, 2006. **47**(9): p. 1558-1568.
59. Berg, A.T., S.F. Berkovic, M.J. Brodie, et al., *Revised terminology and concepts for organization of seizures and epilepsies: report of the ILAE Commission on Classification and Terminology, 2005–2009.* Epilepsia, 2010. **51**(4): p. 676-685.
60. Classification, C.o. and T.o.t.I.L.A. Epilepsy, *Proposal for revised classification of epilepsies and epileptic syndromes.* Epilepsia, 1989. **30**(4): p. 389-399.
61. Holmes, M.D., M. Brown, and D.M. Tucker, *Are "generalized" seizures truly generalized? Evidence of localized mesial frontal and frontopolar discharges in absence.* Epilepsia, 2004. **45**(12): p. 1568-1579.
62. Koutroumanidis, M., K. Aggelakis, and C.P. Panayiotopoulos, *Idiopathic epilepsy with generalized tonic–clonic seizures only versus idiopathic epilepsy with phantom absences and generalized tonic–clonic seizures: One or two syndromes?* Epilepsia, 2008. **49**(12): p. 2050-2062.
63. Friedman, D.E. and L.J. Hirsch, *How long does it take to make an accurate diagnosis in an epilepsy monitoring unit?* Journal of Clinical Neurophysiology, 2009. **26**(4): p. 213-217.

64. Louis, E.K.S. and G.D. Cascino, *Diagnosis of epilepsy and related episodic disorders.* CONTINUUM: Lifelong Learning in Neurology, 2016. **22**(1): p. 15-37.
65. Chemmanam, T., A. Radhakrishnan, S.P. Sarma, and K. Radhakrishnan, *A prospective study on the cost-effective utilization of long-term inpatient video-EEG monitoring in a developing country.* Journal of Clinical Neurophysiology, 2009. **26**(2): p. 123-128.
66. Lüders, H., J. Acharya, C. Baumgartner, et al., *Semiological seizure classification.* Epilepsia, 1998. **39**(9): p. 1006-1013.
67. Hirfanoglu, T., A. Serdaroglu, A. Cansu, et al., *Semiological seizure classification: before and after video-EEG monitoring of seizures.* Pediatric neurology, 2007. **36**(4): p. 231-235.
68. Bennett-Back, O., S. Uliel-Siboni, and U. Kramer, *The yield of video-EEG telemetry evaluation for non-surgical candidate children.* European Journal of Paediatric Neurology, 2016. **20**(6): p. 848-854.
69. Usui, N., P. Kotagal, R. Matsumoto, et al., *Focal semiologic and electroencephalographic features in patients with juvenile myoclonic epilepsy.* Epilepsia, 2005. **46**(10): p. 1668-1676.
70. Aliberti, V., R. Grünewald, C. Panayiotopoulos, and E. Chroni, *Focal electroencephalographic abnormalities in juvenile myoclonic epilepsy.* Epilepsia, 1994. **35**(2): p. 297-301.
71. Foldvary, N., G. Klem, J. Hammel, et al., *The localizing value of ictal EEG in focal epilepsy.* Neurology, 2001. **57**(11): p. 2022-2028.
72. Derry, C.P., A.S. Harvey, M.C. Walker, et al., *NREM arousal parasomnias and their distinction from nocturnal frontal lobe epilepsy: a video EEG analysis.* Sleep, 2009. **32**(12): p. 1637-1644.
73. Sadleir, L.G., I.E. Scheffer, S. Smith, et al., *EEG features of absence seizures in idiopathic generalized epilepsy: impact of syndrome, age, and state.* Epilepsia, 2009. **50**(6): p. 1572-1578.
74. Mullen, S.A., G.L. Carvill, S. Bellows, et al., *Copy number variants are frequent in genetic generalized epilepsy with intellectual disability.* Neurology, 2013. **81**(17): p. 1507-1514.
75. Seneviratne, U., M. Cook, and W. D'Souza, *The electroencephalogram of idiopathic generalized epilepsy.* Epilepsia, 2012. **53**(2): p. 234-248.
76. Foong, M. and U. Seneviratne, *Optimal duration of video-electroencephalographic monitoring to capture seizures.* Journal of Clinical Neuroscience, 2016. **28**: p. 55-60.
77. Oehl, B., K. Götz-Trabert, A. Brandt, et al., *Latencies to first typical generalized spike-wave discharge in idiopathic generalized epilepsies during video-EEG monitoring.* Journal of Clinical Neurophysiology, 2010. **27**(1): p. 1-6.
78. Elger, C.E. and C. Hoppe, *Diagnostic challenges in epilepsy: seizure under-reporting and seizure detection.* The Lancet Neurology, 2018. **17**(3): p. 279-288.
79. Kerling, F., S. Mueller, E. Pauli, and H. Stefan, *When do patients forget their seizures? An electroclinical study.* Epilepsy & Behavior, 2006. **9**(2): p. 281-285.
80. Administration, U.S.F.a.D. *How Drugs are Developed and Approved*. 2019 [cited 2019 12/17/2019]; Available from: https://www.fda.gov/drugs/development-approval-process-drugs/how-drugs-are-developed-and-approved.
81. Blum, D., J. Eskola, J. Bortz, and R. Fisher, *Patient awareness of seizures.* Neurology, 1996. **47**(1): p. 260-264.
82. Langston, M.E. and W.O. Tatum IV, *Focal seizures without awareness.* Epilepsy research, 2015. **109**: p. 163-168.
83. Tatum IV, W.O., L. Winters, M. Gieron, et al., *Outpatient seizure identification: results of 502 patients using computer-assisted ambulatory EEG.* Journal of Clinical Neurophysiology, 2001. **18**(1): p. 14-19.
84. Heo, K., S.D. Han, S.R. Lim, et al., *Patient awareness of complex partial seizures.* Epilepsia, 2006. **47**(11): p. 1931-1935.

85. DuBois, J., L. Boylan, M. Shiyko, et al., *Seizure prediction and recall.* Epilepsy & Behavior, 2010. **18**(1-2): p. 106-109.
86. Helmstaedter, C., M. Kurthen, S. Lux, et al., *Chronic epilepsy and cognition: a longitudinal study in temporal lobe epilepsy.* Annals of Neurology: Official Journal of the American Neurological Association and the Child Neurology Society, 2003. **54**(4): p. 425-432.
87. Jokeit, H. and A. Ebner, *Long term effects of refractory temporal lobe epilepsy on cognitive abilities: a cross sectional study.* Journal of Neurology, Neurosurgery & Psychiatry, 1999. **67**(1): p. 44-50.
88. Oyegbile, T., C. Dow, J. Jones, et al., *The nature and course of neuropsychological morbidity in chronic temporal lobe epilepsy.* Neurology, 2004. **62**(10): p. 1736-1742.
89. Semah, F., M.-C. Picot, C. Adam, et al., *Is the underlying cause of epilepsy a major prognostic factor for recurrence?* Neurology, 1998. **51**(5): p. 1256-1262.
90. Zeman, A. and C. Butler, *Transient epileptic amnesia.* Current opinion in neurology, 2010. **23**(6): p. 610-616.
91. Butler, C.R., K.S. Graham, J.R. Hodges, et al., *The syndrome of transient epileptic amnesia.* Annals of Neurology: Official Journal of the American Neurological Association and the Child Neurology Society, 2007. **61**(6): p. 587-598.
92. Wang, S., B. Jin, L. Yang, et al., *Clinical value and predictors of subclinical seizures in patients with temporal lobe epilepsy undergoing scalp video-EEG monitoring.* Journal of Clinical Neuroscience, 2017. **44**: p. 214-217.
93. Aghaei-Lasboo, A. and R.S. Fisher, *Methods for measuring seizure frequency and severity.* Neurologic clinics, 2016. **34**(2): p. 383-394.
94. Hoppe, C., A. Poepel, and C.E. Elger, *Epilepsy: accuracy of patient seizure counts.* Archives of neurology, 2007. **64**(11): p. 1595-1599.
95. Stefan, H., G. Kreiselmeyer, B. Kasper, et al., *Objective quantification of seizure frequency and treatment success via long-term outpatient video-EEG monitoring: a feasibility study.* Seizure, 2011. **20**(2): p. 97-100.
96. Chen, Z., M.J. Brodie, D. Liew, and P. Kwan, *Treatment outcomes in patients with newly diagnosed epilepsy treated with established and new antiepileptic drugs: a 30-year longitudinal cohort study.* JAMA neurology, 2018. **75**(3): p. 279-286.
97. Moshé, S.L., E. Perucca, P. Ryvlin, and T. Tomson, *Epilepsy: new advances.* The Lancet, 2015. **385**(9971): p. 884-898.
98. Wiebe, S., W.T. Blume, J.P. Girvin, and M. Eliasziw, *A randomized, controlled trial of surgery for temporal-lobe epilepsy.* New England Journal of Medicine, 2001. **345**(5): p. 311-318.
99. Engel, J., M.P. McDermott, S. Wiebe, et al., *Early surgical therapy for drug-resistant temporal lobe epilepsy: a randomized trial.* Jama, 2012. **307**(9): p. 922-930.
100. Dwivedi, R., B. Ramanujam, P.S. Chandra, et al., *Surgery for drug-resistant epilepsy in children.* New England Journal of Medicine, 2017. **377**(17): p. 1639-1647.
101. Engel Jr, J., S. Wiebe, J. French, et al., *Practice parameter: temporal lobe and localized neocortical resections for epilepsy: report of the Quality Standards Subcommittee of the American Academy of Neurology, in association with the American Epilepsy Society and the American Association of Neurological Surgeons.* Epilepsia, 2003. **44**(6): p. 741-751.
102. Asadi-Pooya, A.A., G.R. Stewart, D.J. Abrams, and A. Sharan, *Prevalence and incidence of drug-resistant mesial temporal lobe epilepsy in the United States.* World neurosurgery, 2017. **99**: p. 662-666.
103. Tian, N., M. Boring, R. Kobau, et al., *Active epilepsy and seizure control in adults—United States, 2013 and 2015.* Morbidity and Mortality Weekly Report, 2018. **67**(15): p. 437.

104. Fisher, R.S., J.H. Cross, J.A. French, et al., *Operational classification of seizure types by the International League Against Epilepsy: Position Paper of the ILAE Commission for Classification and Terminology.* Epilepsia, 2017. **58**(4): p. 522-530.
105. Vaughan, K.A., C.L. Ramos, V.P. Buch, et al., *An estimation of global volume of surgically treatable epilepsy based on a systematic review and meta-analysis of epilepsy.* Journal of neurosurgery, 2018. **130**(4): p. 1127-1141.
106. Tanaka, H., H.M. Khoo, F. Dubeau, and J. Gotman, *Association between scalp and intracerebral electroencephalographic seizure-onset patterns: A study in different lesional pathological substrates.* Epilepsia, 2018. **59**(2): p. 420-430.
107. Yun, C.H., S.K. Lee, S.Y. Lee, et al., *Prognostic factors in neocortical epilepsy surgery: multivariate analysis.* Epilepsia, 2006. **47**(3): p. 574-579.
108. Wetjen, N.M., W.R. Marsh, F.B. Meyer, et al., *Intracranial electroencephalography seizure onset patterns and surgical outcomes in nonlesional extratemporal epilepsy.* Journal of neurosurgery, 2009. **110**(6): p. 1147-1152.
109. Tanaka, H., J. Gotman, H.M. Khoo, et al., *Neurophysiological seizure-onset predictors of epilepsy surgery outcome: a multivariable analysis.* Journal of Neurosurgery, 2019. **1**(aop): p. 1-10.
110. Ebersole, J.S. and S.V. Pacia, *Localization of temporal lobe foci by ictal EEG patterns.* Epilepsia, 1996. **37**(4): p. 386-399.
111. Risinger, M., J. Engel, P. Van Ness, et al., *Ictal localization of temporal lobe seizures with scalp/sphenoidal recordings.* Neurology, 1989. **39**(10): p. 1288-1288.
112. Worrell, G.A., E.L. So, J. Kazemi, et al., *Focal ictal β discharge on scalp EEG predicts excellent outcome of frontal lobe epilepsy surgery.* Epilepsia, 2002. **43**(3): p. 277-282.
113. Ebersole, J.S., *Non-invasive pre-surgical evaluation with EEG/MEG source analysis.* Electroencephalography and clinical neurophysiology. Supplement, 1999. **50**: p. 167.
114. Tao, J.X., M. Baldwin, A. Ray, et al., *The impact of cerebral source area and synchrony on recording scalp electroencephalography ictal patterns.* Epilepsia, 2007. **48**(11): p. 2167-2176.
115. Kobulashvili, T., G. Kuchukhidze, F. Brigo, et al., *Diagnostic and prognostic value of noninvasive long-term video-electroencephalographic monitoring in epilepsy surgery: A systematic review and meta-analysis from the E-PILEPSY consortium.* Epilepsia, 2018. **59**(12): p. 2272-2283.
116. Spritzer, S.D., B.D. Pirotte, S.D. Agostini, et al., *The influence of staffing on diagnostic yield of EMU admissions: a comparison study between two institutions.* Epilepsy & Behavior, 2014. **41**: p. 264-267.
117. Sauro, K.M., S. Macrodimitris, C. Krassman, et al., *Quality indicators in an epilepsy monitoring unit.* Epilepsy & Behavior, 2014. **33**: p. 7-11.
118. Alix, J.J., R.H. Kandler, and S.R. Mordekar, *The value of long term EEG monitoring in children: a comparison of ambulatory EEG and video telemetry.* Seizure, 2014. **23**(8): p. 662-665.
119. Kipervasser, S. and M. Neufeld, *Video-EEG monitoring of paroxysmal events in the elderly.* Acta neurologica scandinavica, 2007. **116**(4): p. 221-225.
120. Uldall, P., J. Alving, L. Hansen, et al., *The misdiagnosis of epilepsy in children admitted to a tertiary epilepsy centre with paroxysmal events.* Archives of disease in childhood, 2006. **91**(3): p. 219-221.
121. Keränen, T., S. Rainesalo, and J. Peltola, *The usefulness of video-EEG monitoring in elderly patients with seizure disorders.* Seizure, 2002. **11**(4): p. 269-272.
122. Al Kasab, S., R.A. Dawson, J.L. Jaramillo, and J.J. Halford, *Correlation of seizure frequency and medication down-titration rate during video-EEG monitoring.* Epilepsy & Behavior, 2016. **64**: p. 51-56.
123. Lee, Y.-Y., M.-Y. Lee, I. Chen, et al., *Long-term video-EEG monitoring for paroxysmal events.* Chang Gung Med J, 2009. **32**(3): p. 305-12.

124. Kanner, A.M., S. Stagno, P. Kotagal, and H.H. Morris, *Postictal psychiatric events during prolonged video-electroencephalographic monitoring studies.* Archives of Neurology, 1996. **53**(3): p. 258-263.
125. Tatum, W.O., L.J. Hirsch, M.A. Gelfand, et al., *Assessment of the Predictive Value of Outpatient Smartphone Videos for Diagnosis of Epileptic Seizures.* JAMA neurology, 2020.
126. Smith, S., *EEG in the diagnosis, classification, and management of patients with epilepsy.* Journal of Neurology, Neurosurgery & Psychiatry, 2005. **76**(suppl 2): p. ii2-ii7.
127. Fowle, A.J. and C.D. Binnie, *Uses and abuses of the EEG in epilepsy.* Epilepsia, 2000. **41**: p. S10-S18.
128. Hall-Patch, L., R. Brown, A. House, et al., *Acceptability and effectiveness of a strategy for the communication of the diagnosis of psychogenic nonepileptic seizures.* Epilepsia, 2010. **51**(1): p. 70-78.
129. Benbadis, S., K. Siegrist, W. Tatum, et al., *Short-term outpatient EEG video with induction in the diagnosis of psychogenic seizures.* Neurology, 2004. **63**(9): p. 1728-1730.
130. Bautista, R.E.D., D.D. Spencer, and S.S. Spencer, *EEG findings in frontal lobe epilepsies.* Neurology, 1998. **50**(6): p. 1765-1771.
131. Noe, K., V. Sulc, L. Wong-Kisiel, et al., *Long-term outcomes after nonlesional extratemporal lobe epilepsy surgery.* JAMA neurology, 2013. **70**(8): p. 1003-1008.
132. Caplan, J.P., T. Binius, V.A. Lennon, et al., *Pseudopseudoseizures: conditions that may mimic psychogenic non-epileptic seizures.* Psychosomatics, 2011. **52**(6): p. 501-506.
133. Benbadis, S.R., *The EEG in nonepileptic seizures.* Journal of clinical neurophysiology, 2006. **23**(4): p. 340-352.
134. Tatum, W.O., B.A. Dworetzky, and D.L. Schomer, *Artifact and recording concepts in EEG.* Journal of clinical neurophysiology, 2011. **28**(3): p. 252-263.
135. Catarino, C.B., C. Vollmar, and S. Noachtar, *Paradoxical lateralization of non-invasive electroencephalographic ictal patterns in extra-temporal epilepsies.* Epilepsy research, 2012. **99**(1-2): p. 147-155.
136. Sammaritano, M., A. de Lotbinière, F. Andermann, et al., *False lateralization by surface EEG of seizure onset in patients with temporal lobe epilepsy and gross focal cerebral lesions.* Annals of Neurology: Official Journal of the American Neurological Association and the Child Neurology Society, 1987. **21**(4): p. 361-369.
137. Antony, A.R., S. Abramovici, R.T. Krafty, et al., *Simultaneous scalp EEG improves seizure lateralization during unilateral intracranial EEG evaluation in temporal lobe epilepsy.* Seizure, 2019. **64**: p. 8-15.
138. Ramantani, G., M. Dümpelmann, L. Koessler, et al., *Simultaneous subdural and scalp EEG correlates of frontal lobe epileptic sources.* Epilepsia, 2014. **55**(2): p. 278-288.
139. Sinha, S.R., L.R. Sullivan, D. Sabau, et al., *American clinical neurophysiology society guideline 1: minimum technical requirements for performing clinical electroencephalography.* The Neurodiagnostic Journal, 2016. **56**(4): p. 235-244.
140. Burgess, R.C., *Design and evolution of a system for long-term electroencephalographic and video monitoring of epilepsy patients.* Methods, 2001. **25**(2): p. 231-248.
141. Acharya, J.N., A.J. Hani, J. Cheek, et al., *American clinical neurophysiology society guideline 2: guidelines for standard electrode position nomenclature.* The Neurodiagnostic Journal, 2016. **56**(4): p. 245-252.
142. Nuwer, M.R., G. Comi, R. Emerson, et al., *IFCN standards for digital recording of clinical EEG.* Electroencephalography and clinical Neurophysiology, 1998. **106**(3): p. 259-261.
143. Flink, R., B. Pedersen, A. Guekht, et al., *Guidelines for the use of EEG methodology in the diagnosis of epilepsy: International League Against Epilepsy: Commission Report Commission on*

European Affairs: Subcommission on European Guidelines. Acta Neurologica Scandinavica, 2002. **106**(1): p. 1-7.
144. Rubboli, G., S. Beniczky, S. Claus, et al., *A European survey on current practices in epilepsy monitoring units and implications for patients' safety.* Epilepsy & Behavior, 2015. **44**: p. 179-184.
145. Bragin, A., I. Mody, C.L. Wilson, and J. Engel, *Local generation of fast ripples in epileptic brain.* Journal of Neuroscience, 2002. **22**(5): p. 2012-2021.
146. Pillai, J. and M.R. Sperling, *Interictal EEG and the diagnosis of epilepsy.* Epilepsia, 2006. **47**: p. 14-22.
147. Tao, J.X., A. Ray, S. Hawes-Ebersole, and J.S. Ebersole, *Intracranial EEG substrates of scalp EEG interictal spikes.* Epilepsia, 2005. **46**(5): p. 669-676.
148. Oostenveld, R. and P. Praamstra, *The five percent electrode system for high-resolution EEG and ERP measurements.* Clinical neurophysiology, 2001. **112**(4): p. 713-719.
149. Michel, C.M., G. Lantz, L. Spinelli, et al., *128-channel EEG source imaging in epilepsy: clinical yield and localization precision.* Journal of Clinical Neurophysiology, 2004. **21**(2): p. 71-83.
150. Gavaret, M., L. Maillard, and J. Jung, *High-resolution EEG (HR-EEG) and magnetoencephalography (MEG).* Neurophysiologie Clinique/Clinical Neurophysiology, 2015. **45**(1): p. 105-111.
151. Rubboli, G., F. Bisulli, R. Michelucci, et al., *Sudden falls due to seizure-induced cardiac asystole in drug-resistant focal epilepsy.* Neurology, 2008. **70**(20): p. 1933-1935.
152. Shibasaki, H. and M. Hallett, *Electrophysiological studies of myoclonus.* Muscle & Nerve: Official Journal of the American Association of Electrodiagnostic Medicine, 2005. **31**(2): p. 157-174.
153. Bubrick, E.J., S. Yazdani, and M.K. Pavlova, *Beyond standard polysomnography: advantages and indications for use of extended 10–20 EEG montage during laboratory sleep study evaluations.* Seizure, 2014. **23**(9): p. 699-702.
154. Itoh, Y., H. Oguni, Y. Hirano, and M. Osawa, *Study of epileptic drop attacks in symptomatic epilepsy of early childhood–Differences from those in myoclonic-astatic epilepsy.* Brain and Development, 2015. **37**(1): p. 49-58.
155. Scherg, M., N. Ille, D. Weckesser, et al., *Fast evaluation of interictal spikes in long-term EEG by hyper-clustering.* Epilepsia, 2012. **53**(7): p. 1196-1204.
156. Cho, Y.W., G.K. Motamedi, and K.T. Kim, *The clinical utility of non-invasive video-electroencephalographic monitoring has been diversifying.* Neurol Sci, 2019. **40**(12): p. 2625-2631.
157. Barrett, G., *Jerk-locked averaging: technique and application.* Journal of clinical neurophysiology: official publication of the American Electroencephalographic Society, 1992. **9**(4): p. 495-508.
158. Oguni, H., K. Mukahira, M. Oguni, et al., *Video-polygraphic analysis of myoclonic seizures in juvenile myoclonic epilepsy.* Epilepsia, 1994. **35**(2): p. 307-316.
159. Brown, P., S. Farmer, D. Halliday, et al., *Coherent cortical and muscle discharge in cortical myoclonus.* Brain, 1999. **122**(3): p. 461-472.
160. Foged, M.T., Martens, T., Pinborg, L.H., Hamrouni, N., Litman, M., Rubboli, G., Leffers, A.M., Ryvlin, P., Jespersen, B., Paulson, O.B. and Fabricius, M. Diagnostic added value of electrical source imaging in presurgical evaluation of patients with epilepsy: A prospective study. Clinical Neurophysiology, 2020. 131(1), p.324-329.
161. Holmes, M.D., D.M. Tucker, J.M. Quiring, et al., *Comparing noninvasive dense array and intracranial electroencephalography for localization of seizures.* Neurosurgery, 2010. **66**(2): p. 354-362.
162. Brna, P., M. Duchowny, T. Resnick, et al., *The diagnostic utility of intracranial EEG monitoring for epilepsy surgery in children.* Epilepsia, 2015. **56**(7): p. 1065-1070.

163. Jayakar, P., W.D. Gaillard, M. Tripathi, et al., *Diagnostic test utilization in evaluation for resective epilepsy surgery in children.* Epilepsia, 2014. **55**(4): p. 507-518.
164. Lesser, R.P., *Psychogenic seizures.* Neurology, 1996. **46**(6): p. 1499-1507.
165. Cascino, G.D. *Clinical indications and diagnostic yield of video-electroencephalographic monitoring in patients with seizures and spells*. in *Mayo Clinic Proceedings*. 2002. Elsevier.
166. Chowdhury, F., L. Nashef, and R. Elwes, *Misdiagnosis in epilepsy: a review and recognition of diagnostic uncertainty.* European journal of neurology, 2008. **15**(10): p. 1034-1042.
167. Hamandi, K., S. Beniczky, B. Diehl, et al., *Current practice and recommendations in UK epilepsy monitoring units. Report of a national survey and workshop.* Seizure, 2017. **50**: p. 92-98.
168. Brunnhuber, F., D. Amin, Y. Nguyen, et al., *Development, evaluation and implementation of video-EEG telemetry at home.* Seizure, 2014. **23**(5): p. 338-343.
169. Beniczky, S.A., A. Fogarasi, M. Neufeld, et al., *Seizure semiology inferred from clinical descriptions and from video recordings. How accurate are they?* Epilepsy & Behavior, 2012. **24**(2): p. 213-215.
170. Chen, D.K., K.D. Graber, C.T. Anderson, and R.S. Fisher, *Sensitivity and specificity of video alone versus electroencephalography alone for the diagnosis of partial seizures.* Epilepsy & Behavior, 2008. **13**(1): p. 115-118.
171. Watemberg, N., B. Tziperman, R. Dabby, et al., *Adding video recording increases the diagnostic yield of routine electroencephalograms in children with frequent paroxysmal events.* Epilepsia, 2005. **46**(5): p. 716-719.
172. Serles, W., Z. Caramanos, G. Lindinger, et al., *Combining ictal surface-electroencephalography and seizure semiology improves patient lateralization in temporal lobe epilepsy.* Epilepsia, 2000. **41**(12): p. 1567-1573.
173. Bidwell, J., T. Khuwatsamrit, B. Askew, et al., *Seizure reporting technologies for epilepsy treatment: A review of clinical information needs and supporting technologies.* Seizure, 2015. **32**: p. 109-117.
174. Blume, W.T., H.O. Lüders, E. Mizrahi, et al., *Glossary of descriptive terminology for ictal semiology: report of the ILAE task force on classification and terminology.* Epilepsia, 2001. **42**(9): p. 1212-1218.
175. Gröppel, G., T. Kapitany, and C. Baumgartner, *Cluster analysis of clinical seizure semiology of psychogenic nonepileptic seizures.* Epilepsia, 2000. **41**(5): p. 610-614.
176. Seneviratne, U., D. Reutens, and W. D'Souza, *Stereotypy of psychogenic nonepileptic seizures: Insights from video-EEG monitoring.* Epilepsia, 2010. **51**(7): p. 1159-1168.
177. Erba, G., G. Giussani, A. Juersivich, et al., *The semiology of psychogenic nonepileptic seizures revisited: can video alone predict the diagnosis? Preliminary data from a prospective feasibility study.* Epilepsia, 2016. **57**(5): p. 777-785.
178. Syed, T.U., W.C. LaFrance Jr, E.S. Kahriman, et al., *Can semiology predict psychogenic nonepileptic seizures? A prospective study.* Annals of neurology, 2011. **69**(6): p. 997-1004.
179. Wadwekar, V., P.P. Nair, A. Murgai, et al., *Semiologic classification of psychogenic non epileptic seizures (PNES) based on video EEG analysis: do we need new classification systems?* Seizure, 2014. **23**(3): p. 222-226.
180. Tufenkjian, K. and H.O. Lüders, *Seizure semiology: its value and limitations in localizing the epileptogenic zone.* Journal of Clinical Neurology, 2012. **8**(4): p. 243-250.
181. Tinuper, P., C. Grassi, F. Bisulli, et al., *Split-screen synchronized display. A useful video-EEG technique for studying paroxysmal phenomena.* Epileptic disorders, 2004. **6**(1): p. 27-30.
182. Shafer, P.O., J.M. Buelow, K. Noe, et al., *A consensus-based approach to patient safety in epilepsy monitoring units: recommendations for preferred practices.* Epilepsy & Behavior, 2012. **25**(3): p. 449-456.

183. Atkinson, M., A. Shah, K. Hari, et al., *Safety considerations in the epilepsy monitoring unit for psychogenic nonepileptic seizures.* Epilepsy & Behavior, 2012. **25**(2): p. 176-180.
184. Buelow, J.M., M. Privitera, P. Levisohn, and G.L. Barkley, *A description of current practice in epilepsy monitoring units.* Epilepsy & Behavior, 2009. **15**(3): p. 308-313.
185. Caplin, D.A., J.K. Rao, F. Filloux, et al., *Development of performance indicators for the primary care management of pediatric epilepsy: expert consensus recommendations based on the available evidence.* Epilepsia, 2006. **47**(12): p. 2011-2019.
186. Atkinson, M., K. Hari, K. Schaefer, and A. Shah, *Improving safety outcomes in the epilepsy monitoring unit.* Seizure, 2012. **21**(2): p. 124-127.
187. Noe, K.H. and J.F. Drazkowski. *Safety of long-term video-electroencephalographic monitoring for evaluation of epilepsy*. in *Mayo Clinic Proceedings*. 2009. Elsevier.
188. Spanaki, M.V., C. McCloskey, V. Remedio, et al., *Developing a culture of safety in the epilepsy monitoring unit: a retrospective study of safety outcomes.* Epilepsy & Behavior, 2012. **25**(2): p. 185-188.
189. De Marchi, L.R., J.T. Corso, A.C. Zetehaku, et al., *Efficacy and safety of a video-EEG protocol for genetic generalized epilepsies.* Epilepsy & Behavior, 2017. **70**: p. 187-192.
190. Espinosa, P., J. Lee, U. Tedrow, et al., *Sudden unexpected near death in epilepsy: malignant arrhythmia from a partial seizure.* Neurology, 2009. **72**(19): p. 1702-1703.
191. Shafer, P., J. Buelow, D. Ficker, et al., *Risk of adverse events on epilepsy monitoring units: a survey of epilepsy professionals.* Epilepsy & Behavior, 2011. **20**(3): p. 502-505.
192. Spritzer, S.D., K.C. Riordan, J. Berry, et al., *Fall prevention and bathroom safety in the epilepsy monitoring unit.* Epilepsy & Behavior, 2015. **48**: p. 75-78.
193. Craciun, L., J. Alving, E. Gardella, et al., *Do patients need to stay in bed all day in the Epilepsy Monitoring Unit? Safety data from a non-restrictive setting.* Seizure, 2017. **49**: p. 13-16.
194. Pati, S., V.M. Kumaraswamy, A. Deep, et al., *Characteristics of falls in the epilepsy monitoring unit: a retrospective study.* Epilepsy & Behavior, 2013. **29**(1): p. 1-3.
195. DeToledo, J.C. and M.R. Lowe, *Seizures, lateral decubitus, aspiration, and shoulder dislocation: time to change the guidelines?* Neurology, 2001. **56**(3): p. 290-291.
196. Tatum, W.O., E.K. Acton, M.E. Langston, et al., *Multimodality peak lctal vital signs during video-EEG monitoring.* Seizure, 2016. **40**: p. 15-20.
197. Tényi, D., C. Gyimesi, P. Kupó, et al., *Ictal asystole: a systematic review.* Epilepsia, 2017. **58**(3): p. 356-362.
198. Ficker, D.M., E. So, W. Shen, et al., *Population-based study of the incidence of sudden unexplained death in epilepsy.* Neurology, 1998. **51**(5): p. 1270-1274.
199. Ryvlin, P., L. Nashef, S.D. Lhatoo, et al., *Incidence and mechanisms of cardiorespiratory arrests in epilepsy monitoring units (MORTEMUS): a retrospective study.* The Lancet Neurology, 2013. **12**(10): p. 966-977.
200. Kandler, R., M. Lai, A. Ponnusamy, et al., *The safety of UK video telemetry units: results of a national service evaluation.* Seizure, 2013. **22**(10): p. 872-876.
201. Hedegärd, E., J. Bjellvi, A. Edelvik, et al., *Complications to invasive epilepsy surgery workup with subdural and depth electrodes: a prospective population-based observational study.* J Neurol Neurosurg Psychiatry, 2014. **85**(7): p. 716-720.
202. Starmer, C.F., H.D. McIntosh, and R.E. Whalen, *Electrical hazards and cardiovascular function.* New England Journal of Medicine, 1971. **284**(4): p. 181-186.
203. Leitgeb, N. and J. Schröttner, *Electric current perception study challenges electric safety limits.* Journal of medical engineering & technology, 2002. **26**(4): p. 168-172.
204. Burgess, R.C., *Electrical safety*, in *Handbook of clinical neurology*. 2019, Elsevier. p. 67-81.

205. Cooper, M.A. *Emergent care of lightning and electrical injuries*. in *Seminars in neurology*. 1995. © 1995 by Thieme Medical Publishers, Inc.
206. Geddes, L. and R. Roeder, *Direct-current injury: electrochemical aspects.* Journal of clinical monitoring and computing, 2004. **18**(3): p. 157-161.
207. Shin, H.W., P.B. Pennell, J.W. Lee, et al., *Efficacy of safety signals in the epilepsy monitoring unit (EMU): Should we worry?* Epilepsy & Behavior, 2012. **23**(4): p. 458-461.
208. Malloy, K., D. Cardenas, A. Blackburn, et al., *Time to response and patient visibility during tonic–clonic seizures in the epilepsy monitoring unit.* Epilepsy & Behavior, 2018. **89**: p. 84-88.
209. Beniczky, S., M. Neufeld, B. Diehl, et al., *Testing patients during seizures: A European consensus procedure developed by a joint taskforce of the ILAE–Commission on European Affairs and the European Epilepsy Monitoring Unit Association.* Epilepsia, 2016. **57**(9): p. 1363-1368.
210. Touloumes, G., E. Morse, W.C. Chen, et al., *Human bedside evaluation versus automatic responsiveness testing in epilepsy (ARTiE).* Epilepsia, 2016. **57**(1): p. e28-e32.
211. Centers, N.A.o.E., R.J. Gumnit, and T.S. Walczak, *Guidelines for essential services, personnel, and facilities in specialized epilepsy centers in the United States.* Epilepsia, 2001. **42**(6): p. 804-814.
212. Labiner, D.M., A.I. Bagic, S.T. Herman, et al., *Essential services, personnel, and facilities in specialized epilepsy centers--revised 2010 guidelines.* Epilepsia, 2010. **51**(11): p. 2322-33.
213. Bingham, E. and V. Patterson, *Nurse led epilepsy clinics: a telemedicine approach.(ABN Abstracts).* Journal of Neurology, Neurosurgery and Psychiatry, 2002. **73**(2): p. 216-217.
214. Wu, S., N.P. Issa, S.L. Rose, et al., *Impact of periictal nurse interventions on postictal generalized EEG suppression in generalized convulsive seizures.* Epilepsy & Behavior, 2016. **58**: p. 22-25.
215. Dericioğlu, N., M. Albakir, and S. Saygi, *The role of patient companions in long-term video-EEG monitoring.* Seizure, 2000. **9**(2): p. 124-127.
216. Benbadis, S.R., E. O'Neill, W.O. Tatum, and L. Heriaud, *Outcome of prolonged video-EEG monitoring at a typical referral epilepsy center.* Epilepsia, 2004. **45**(9): p. 1150-1153.
217. Moseley, B.D., S. Dewar, Z. Haneef, et al., *Reasons for prolonged length of stay in the epilepsy monitoring unit.* Epilepsy research, 2016. **127**: p. 175-178.
218. Bettini, L., A. Croquelois, M. Maeder-Ingvar, and A.O. Rossetti, *Diagnostic yield of short-term video-EEG monitoring for epilepsy and PNESs: a European assessment.* Epilepsy & Behavior, 2014. **39**: p. 55-58.
219. Villanueva, V., A. Gutierrez, M. Garcia, et al., *Usefulness of video-eeg monitoring in patients with drugresistant epilepsy.* Neurología (English Edition), 2011. **26**(1): p. 6-12.
220. Seneviratne, U., Z. Rahman, A. Diamond, and M. Brusco, *The yield and clinical utility of outpatient short-term video-electroencephalographic monitoring: a five-year retrospective study.* Epilepsy & Behavior, 2012. **25**(3): p. 303-306.
221. Lazarus, J., M. Bhatia, G. Shukla, et al., *A study of nonepileptic seizures in an Indian population.* Epilepsy & Behavior, 2003. **4**(5): p. 496-499.
222. Zanzmera, P., A. Sharma, K. Bhatt, et al., *Can short-term video-EEG substitute long-term video-EEG monitoring in psychogenic nonepileptic seizures? A prospective observational study.* Epilepsy & Behavior, 2019. **94**: p. 258-263.
223. Caller, T.A., J.J. Chen, J.J. Harrington, et al., *Predictors for readmissions after video-EEG monitoring.* Neurology, 2014. **83**(5): p. 450-455.
224. Hupalo, M., J.W. Smigielski, and D.J. Jaskolski, *Optimal time of duration of a long-term video-EEG monitoring in paroxysmal events–A retrospective analysis of 282 sessions in 202 patients.* Neurologia i neurochirurgia polska, 2016. **50**(5): p. 331-335.
225. Liu, S., C. Gurses, Z. Sha, et al., *Stereotyped high-frequency oscillations discriminate seizure onset zones and critical functional cortex in focal epilepsy.* Brain, 2018. **141**(3): p. 713-730.

226. King-Stephens, D., E. Mirro, P.B. Weber, et al., *Lateralization of mesial temporal lobe epilepsy with chronic ambulatory electrocorticography.* Epilepsia, 2015. **56**(6): p. 959-967.
227. Asano, E., C. Juhasz, A. Shah, et al., *Role of subdural electrocorticography in prediction of long-term seizure outcome in epilepsy surgery.* Brain, 2009. **132**(4): p. 1038-1047.
228. Leach, J.P., L.J. Stephen, C. Salveta, and M.J. Brodie, *Which electroencephalography (EEG) for epilepsy? The relative usefulness of different EEG protocols in patients with possible epilepsy.* Journal of Neurology, Neurosurgery & Psychiatry, 2006. **77**(9): p. 1040-1042.
229. Kane, N., L. Grocott, R. Kandler, et al., *Hyperventilation during electroencephalography: safety and efficacy.* Seizure, 2014. **23**(2): p. 129-134.
230. Craciun, L., E.T. Varga, I. Mindruta, et al., *Diagnostic yield of five minutes compared to three minutes hyperventilation during electroencephalography.* Seizure, 2015. **30**: p. 90-92.
231. Excellence, N.I.f.C., *Epilepsies: diagnosis and management (CG137).* Retrieved, 2012. **12**: p. 18.
232. da Silva Sousa, P., K. Lin, E. Garzon, et al., *Self-perception of factors that precipitate or inhibit seizures in juvenile myoclonic epilepsy.* Seizure, 2005. **14**(5): p. 340-346.
233. Pedersen, S. and K. Petersen, *Juvenile myoclonic epilepsy: clinical and EEG features.* Acta neurologica scandinavica, 1998. **97**(3): p. 160-163.
234. Angus-Leppan, H., *Seizures and adverse events during routine scalp electroencephalography: a clinical and EEG analysis of 1000 records.* Clinical neurophysiology, 2007. **118**(1): p. 22-30.
235. Guaranha, M.S.B., P. Da Silva Sousa, G.M. De Araújo-Filho, et al., *Provocative and inhibitory effects of a video-EEG neuropsychologic protocol in juvenile myoclonic epilepsy.* Epilepsia, 2009. **50**(11): p. 2446-2455.
236. Pratt, K.L., R.H. Mattson, N.J. Weikers, and R. Williams, *EEG activation of epileptics following sleep deprivation: a prospective study of 114 cases.* Electroencephalography and Clinical Neurophysiology, 1968. **24**(1): p. 11-15.
237. Degen, R., *A study of the diagnostic value of waking and sleep EEGs after sleep deprivation in epileptic patients on anticonvulsive therapy.* Electroencephalography and clinical neurophysiology, 1980. **49**(5-6): p. 577-584.
238. Kasteleijn-Nolst Trenité, D.G., *Provoked and reflex seizures: surprising or common?* Epilepsia, 2012. **53**: p. 105-113.
239. Carpay, J., A. De Weerd, R. Schimsheimer, et al., *The diagnostic yield of a second EEG after partial sleep deprivation: a prospective study in children with newly diagnosed seizures.* Epilepsia, 1997. **38**(5): p. 595-599.
240. Gustafsson, G., A. Broström, M. Ulander, et al., *Occurrence of epileptiform discharges and sleep during EEG recordings in children after melatonin intake versus sleep-deprivation.* Clinical Neurophysiology, 2015. **126**(8): p. 1493-1497.
241. Jonas, J., J.-P. Vignal, C. Baumann, et al., *Effect of hyperventilation on seizure activation: potentiation by antiepileptic drug tapering.* Journal of Neurology, Neurosurgery & Psychiatry, 2011. **82**(8): p. 928-930.
242. Guaranha, M.S., E. Garzon, C.A. Buchpiguel, et al., *Hyperventilation revisited: Physiological effects and efficacy on focal seizure activation in the era of video-EEG monitoring.* Epilepsia, 2005. **46**(1): p. 69-75.
243. Koepp, M.J., L. Caciagli, R.M. Pressler, et al., *Reflex seizures, traits, and epilepsies: from physiology to pathology.* The Lancet Neurology, 2016. **15**(1): p. 92-105.
244. Popkirov, S., W. Grönheit, and J. Wellmer, *A systematic review of suggestive seizure induction for the diagnosis of psychogenic nonepileptic seizures.* Seizure, 2015. **31**: p. 124-132.
245. Abubakr, A., I. Ifeayni, and I. Wambacq, *The efficacy of routine hyperventilation for seizure activation during prolonged video-electroencephalography monitoring.* Journal of Clinical Neuroscience, 2010. **17**(12): p. 1503-1505.

246. Goyal, G., J. Kalita, and U.K. Misra, *Utility of different seizure induction protocols in psychogenic nonepileptic seizures.* Epilepsy research, 2014. **108**(6): p. 1120-1127.
247. Devinsky, O. and R. Fisher, *Ethical use of placebos and provocative testing in diagnosing nonepileptic seizures.* Neurology, 1996. **47**(4): p. 866-870.
248. Gates, J.R., *Provocative testing should not be used for nonepileptic seizures.* Archives of Neurology, 2001. **58**(12): p. 2065-2066.
249. Leeman, B.A., *Provocative techniques should not be used for the diagnosis of psychogenic nonepileptic seizures.* Epilepsy & Behavior, 2009. **15**(2): p. 110-114.
250. Lancman, M.E., J.J. Asconapé, W.J. Craven, et al., *Predictive value of induction of psychogenic seizures by suggestion.* Annals of Neurology: Official Journal of the American Neurological Association and the Child Neurology Society, 1994. **35**(3): p. 359-361.
251. Walczak, T.S., D.T. Williams, and W. Berten, *Utility and reliability of placebo infusion in the evaluation of patients with seizures.* Neurology, 1994. **44**(3 Part 1): p. 394-394.
252. Benbadis, S., K. Johnson, K. Anthony, et al., *Induction of psychogenic nonepileptic seizures without placebo.* Neurology, 2000. **55**(12): p. 1904-1905.
253. Barry, J.J., O. Atzman, and M.J. Morrell, *Discriminating between epileptic and nonepileptic events: the utility of hypnotic seizure induction.* Epilepsia, 2000. **41**(1): p. 81-84.
254. Chen, D.K., H. Dave, K. Gadelmola, et al., *Provocative induction of psychogenic nonepileptic seizures: Noninferiority of an induction technique without versus with placebo.* Epilepsia, 2018. **59**(11): p. e161-e165.
255. Chen, D.K., S. Izadyar, R.L. Collins, et al., *Induction of psychogenic nonepileptic events: success rate influenced by prior induction exposure, ictal semiology, and psychological profiles.* Epilepsia, 2011. **52**(6): p. 1063-1070.
256. Novitskaya, Y., M. Hintz, and A. Schulze-Bonhage, *Rapid antiepileptic drug withdrawal may obscure localizing information obtained during presurgical EEG recordings.* Epileptic Disorders, 2018. **20**(2): p. 151-157.
257. Dworetzky, B.A. and J. Kapur, *Gaining perspective on SUDEP: the new guideline*. 2017, AAN Enterprises.
258. Rose, A., P. McCabe, F. Gilliam, et al., *Occurrence of seizure clusters and status epilepticus during inpatient video-EEG monitoring.* Neurology, 2003. **60**(6): p. 975-978.
259. Di Gennaro, G., A. Picardi, A. Sparano, et al., *Seizure clusters and adverse events during pre-surgical video-EEG monitoring with a slow anti-epileptic drug (AED) taper.* Clinical neurophysiology, 2012. **123**(3): p. 486-488.
260. Wang-Tilz, Y., C. Tilz, B. Wang, et al., *Changes of seizures activity during rapid withdrawal of lamotrigine.* European journal of neurology, 2005. **12**(4): p. 280-288.
261. Kumar, S., B. Ramanujam, P. Chandra, et al., *Randomized controlled study comparing the efficacy of rapid and slow withdrawal of antiepileptic drugs during long-term video-EEG monitoring.* Epilepsia, 2018. **59**(2): p. 460-467.
262. Rizvi, S.A., L. Hernandez-Ronquillo, A. Wu, and J.F.T. Zenteno, *Is rapid withdrawal of anti-epileptic drug therapy during video EEG monitoring safe and efficacious?* Epilepsy research, 2014. **108**(4): p. 755-764.
263. Henning, O., A. Baftiu, S. Johannessen, and C.J. Landmark, *Withdrawal of antiepileptic drugs during presurgical video-EEG monitoring: an observational study for evaluation of current practice at a referral center for epilepsy.* Acta Neurologica Scandinavica, 2014. **129**(4): p. 243-251.
264. Stefani, M., H. Arima, and A. Mohamed, *Withdrawal of anti-epileptic medications during video EEG monitoring does not alter ECG parameters or HRV.* Epilepsy research, 2013. **106**(1-2): p. 222-229.

265. Zhou, D., Y. Wang, P. Hopp, et al., *Influence on ictal seizure semiology of rapid withdrawal of carbamazepine and valproate in monotherapy.* Epilepsia, 2002. **43**(4): p. 386-393.
266. Shih, J.J., J.B. Whitlock, N. Chimato, et al., *Epilepsy treatment in adults and adolescents: expert opinion, 2016.* Epilepsy & Behavior, 2017. **69**: p. 186-222.
267. Guld, A., A. Sabers, and T. Kjaer, *Drug taper during long-term video-EEG monitoring: efficiency and safety.* Acta Neurologica Scandinavica, 2017. **135**(3): p. 302-307.
268. van Griethuysen, R., W.A. Hofstra, S.M. van der Salm, et al., *Safety and efficiency of medication withdrawal at home prior to long-term EEG video-monitoring.* Seizure, 2018. **56**: p. 9-13.
269. Tzallas, A.T., M.G. Tsipouras, and D.I. Fotiadis, *Epileptic seizure detection in EEGs using time–frequency analysis.* IEEE transactions on information technology in biomedicine, 2009. **13**(5): p. 703-710.
270. Gotman, J., *Automatic detection of seizures and spikes.* Journal of Clinical Neurophysiology, 1999. **16**(2): p. 130-140.
271. Fürbass, F., P. Ossenblok, M. Hartmann, et al., *Prospective multi-center study of an automatic online seizure detection system for epilepsy monitoring units.* Clinical Neurophysiology, 2015. **126**(6): p. 1124-1131.
272. Kelly, K., D. Shiau, R. Kern, et al., *Assessment of a scalp EEG-based automated seizure detection system.* Clinical Neurophysiology, 2010. **121**(11): p. 1832-1843.
273. Scheuer, M.L., A. Bagic, and S.B. Wilson, *Spike detection: Inter-reader agreement and a statistical Turing test on a large data set.* Clinical Neurophysiology, 2017. **128**(1): p. 243-250.
274. Saab, M. and J. Gotman, *A system to detect the onset of epileptic seizures in scalp EEG.* Clinical Neurophysiology, 2005. **116**(2): p. 427-442.
275. Hopfengärtner, R., B.S. Kasper, W. Graf, et al., *Automatic seizure detection in long-term scalp EEG using an adaptive thresholding technique: a validation study for clinical routine.* Clinical Neurophysiology, 2014. **125**(7): p. 1346-1352.
276. Salinsky, M., *A practical analysis of computer based seizure detection during continuous video-EEG monitoring.* Electroencephalography and clinical Neurophysiology, 1997. **103**(4): p. 445-449.
277. Dobesberger, J., G. Walser, I. Unterberger, et al., *Video-EEG monitoring: safety and adverse events in 507 consecutive patients.* Epilepsia, 2011. **52**(3): p. 443-452.
278. Dobesberger, J., J. Höfler, M. Leitinger, et al., *Personalized safety measures reduce the adverse event rate of long-term video EEG.* Epilepsia Open, 2017. **2**(4): p. 400-414.
279. Glauser, T., S. Shinnar, D. Gloss, et al., *Evidence-based guideline: treatment of convulsive status epilepticus in children and adults: report of the Guideline Committee of the American Epilepsy Society.* Epilepsy currents, 2016. **16**(1): p. 48-61.
280. Maglalang, P.D., D. Rautiola, R.A. Siegel, et al., *Rescue therapies for seizure emergencies: new modes of administration.* Epilepsia, 2018. **59**: p. 207-215.
281. Dobesberger, J., A.J. Ristić, G. Walser, et al., *Duration of focal complex, secondarily generalized tonic–clonic, and primarily generalized tonic–clonic seizures—A video-EEG analysis.* Epilepsy & Behavior, 2015. **49**: p. 111-117.
282. Tsai, C., S. Mintzer, M. Nei, et al., *A Retrospective Review of Rescue Medications used During Video EEG-Monitoring in the Epilepsy Monitoring Unit (P4. 198)*. 2016, AAN Enterprises.
283. NAEC *Sample Protocol #3:Medication reduction to increase seizure yield.* 2018.
284. Kaplan, P.W. and S.R. Benbadis, *How to write an EEG report: dos and don'ts.* Neurology, 2013. **80**(1 Supplement 1): p. S43-S46.
285. Beniczky, S., H. Aurlien, J.C. Brøgger, et al., *Standardized computer-based organized reporting of EEG: SCORE.* Epilepsia, 2013. **54**(6): p. 1112-1124.
286. Tatum, W.O., *How not to read an EEG: introductory statements.* Neurology, 2013. **80**(1 Supplement 1): p. S1-S3.

287. Hirsch, L., S. LaRoche, N. Gaspard, et al., *American clinical neurophysiology society's standardized critical care EEG terminology: 2012 version.* Journal of clinical neurophysiology, 2013. **30**(1): p. 1-27.
288. Gaspard, N., L.J. Hirsch, S.M. LaRoche, et al., *Interrater agreement for critical care EEG terminology.* Epilepsia, 2014. **55**(9): p. 1366-1373.
289. Stroink, H., R.-J. Schimsheimer, A.W. de Weerd, et al., *Interobserver reliability of visual interpretation of electroencephalograms in children with newly diagnosed seizures.* Developmental medicine and child neurology, 2006. **48**(5): p. 374-377.